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CYRENAICA.

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I. The Problem of Cyrenaica.

BETWEEN the lowlands of Egypt and of western Tripoli Africa projects northward as the high plateau of Cyrenaica which enjoys a bracing climate, a rich easily-tilled soil, and the finest mountain scenery on the northern coast of Africa. It stands moreover beside the northern end of the caravan road across the Sahara, which brought to the Mediterranean the tropical products of the Sudan. No wonder this favoured land, being the nearest part of Africa to Greece, was early colonized by Greeks; and about 623 B.C. a party of emigrants under Battus established the famous city of Cyrene beside the fountain of Apollo, one of the chief springs on the northern front of the Cyrenaican plateau. The country proved a very useful supplement to Greece. It had no permanent rivers and its water-supply was scanty; but the Greeks were accustomed to similar conditions during the summer in their own land. The plateau however, after wet winters, produced abundant crops of corn; its coastal plains grew rice and dates; the flowers of its limestone moors yielded honey which rivalled that of Hymettus; and from its herbs were extracted condiments and drugs that were highly prized by epicures and apothecaries who could not draw on the spice islands of the East. So the Greek colony flourished; it was known from its five cities as the Pentapolis; and its citizens proved famous for intellectual power and physical prowess. There the philosophers of the Cyrenaic school partially anticipated Hume; thence came many of the

victors in the Olympic games; and it has special claims to the respect of geographers as the home of Eratosthenes and the site of localities so famous in classical folklore as the River Lethe and the Gardens of the Hesperides.

With the rise of the Roman Empire in Africa Cyrenaica became still more important. Wide desert wastes lay in front of it to east, south, and west; aud this relatively fertile plateau was indispensable to the overland route from Egypt to Carthage. The country is littered with evidence of the Roman occupation. The roads from the ports to the cities on the plateau are still marked by the ruts worn by heavy traffic. Innumerable remains of terraced cultivation, many irrigation channels, wells, and aqueducts show that the Romans used to the utmost every available supply of water. Thanks to their skill and care Cyrenaica then attained the zenith of its prosperity; it was inhabited by a quarter or perhaps half a million of inhabitants, among whom was its most world-famous citizen, Simon of Cyrene. With the fall of Rome and the conquest of North Africa by the Arabs, Cyrenaica was devastated, its water-supply works fell into ruins, and it lost its value as a commercial station with the close of the regular traffic between Egypt and Algeria. The traditions of the ancient prosperity of the country are still recounted, and are confirmed by ample existing evidence. For the ruins of the cities are still uncovered; the broken piers of Marsa Susa help Greek smugglers to land arms for the Senusi, where the Romans shipped their cargoes of grain; and the decorated Greek tombs of Cyrene serve as goat pens to Arab settlers at the Fountain of Apollo. Yet in spite of its classic interest Cyrenaica is now the least known and most idle land on the shores of the Mediterranean.

After a long period of independence under the Barbary pirates, Turkey reannexed all Tripoli in 1835; its development however was beyond the Turk. Traveller after traveller in Cyrenaica has vividly contrasted its modern desolation with its classical prosperity, and poured forth rhapsodies over its beauty and fertility. It is true that Leo the Moor in 1600 described the country as "a rough and unpleasant place, being almost utterly devoid of water and corne" (Leo, 1600, pp. 266, 25); and its Arab inhabitants as a "verie rude, forlorne, beggerly, leane, and hunger-starved people, having God (no doubt) alwaies displeased against them." The more pleasing modern accounts of the country begin with the reports of Della Cella, who in 1817 visited it as medical officer attached to a military expedition from Tripoli. "The olive and the trees mentioned by Theophrastus, as of extraordinary beauty in Cyrenaica, still flourish there," he said, "with such vigour and luxuriance as I never saw anywhere surpassed." And "struck as I frequently was with this extraordinary degree of fruitfulness and with the pure and temperate quality of the air," he repeatedly referred to its many advantages for colonization ('Della Cella,' 1822, p. 118). Sir F. W. and H. W. Beechey, who surveyed the classical antiquities of

Cyrene in 1821 and 1822, repeatedly describe the fertility of the land; they were often troubled by the rankness of the vegetation and were enthusiastic over its continuous succession of beauties. They compared its valleys to those of Switzerland and Savoy; they declared that they could scarcely recollect anywhere more pleasing scenes, and of a ravine near Ptolemeta that they could never forget "this enchanting retreat" (Beechey, 1828, pp. 358, 478).

Sir R. Murdoch Smith and E. A. Porcher, who brought from Cyrene the statues now in the British Museum, declared (1864, p. 2) the locality "scarcely inferior for beauty and fertility to any on the surface of the globe;" yet they represent the population of Cyrenaica as insignificant.

Playfair in Murray's 'Handbook to the Mediterranean' (1881, p. 41) describes the country as "a succession of wooded hills and smiling prairies, well watered by rain and perennial springs; the climate is healthy and cool. . . ."

According to F. B. Goddard (1884, p. 33), "It is probable that of all the countries bordering the Mediterranean none has a more luxuriant vegetation." (See also G. Dennis, "On Recent Excavations in the Greek Cemeteries of the Cyrenaica," *Trans. R. Soc.*, Lit. Ser. 2, vol. 9, 1870, p. 142.)

Dr. G. Hildebrand (1904) summarizes the opinions of travellers in Cyrenaica as "overwhelmingly enthusiastic" and "unanimous in the opinion that here lies a region brilliantly endowed by Nature" and capable of providing a home for millions of Europeans.

Mr. Weld Blundell, writing from Cyrene in 1894 to the *Geographical Journal* (vol. 5, p. 168), declares that "the rhapsodies of former travellers scarcely do justice to it. It is like a ten days' ride through the Malvern Hills and Shropshire, if you could imagine all the evidence of human beings in the way of buildings, etc., removed, and arbutus, laurestinus, and juniper, etc., instead of oaks and elms. Stretches of beautifully fertile plains, with rich red soil covered with flowers and shrubs, and well-sheltered valleys and glades of fine short grass, not like the ordinary coarse growth of the tropics, but like an old pasture and even a lawn-tennis ground! There are whole square miles like an English park, and one almost expects to see a head gardener appear to warn you off the grass. In spite of this I do not think that, with the exception of a little village called Merj (ancient Barka) and this place, I have seen fifty inhabitants in the whole journey from Benghasi."

Mr. Israel Zangwill ('Introduction to Report of the Ito Expedition,' p. vii.) after quoting many opinions on the country concludes "from the earliest records up to the very year of the Ito expedition, there is a positive chorus of unanimity. Cyrenaica was of yore an earthly Paradise."

The attractiveness of the scenery, the richness of the soil, and the glamour of its ancient glory have led to repeated schemes for the colonization and development of Cyrenaica. The Turks settled there some

thousands of Mohammedans who fled from Crete when that island was transferred to Greece; and Hildebrand (1904, pp. 69–76) enumerates eleven schemes, Russian, Turkish, British, American, French and Italian, during the past century and a half for the resettlement of this promising but apparently derelict land. After the Berlin Treaty Italy turned her attention to Tripoli and endeavoured to gain a foothold by a policy of commercial penetration. Missions, schools, agencies and banks were established; and numerous Italian explorers, Mamoli, Giuseppe Hamann, Bottiglia, and Camperio, visited the country. Rizzetto discussed its commercial value. But the results were disappointing. The commercial agencies proved financial failures. The explorers represented Cyrenaica as having so much barren land and so little water that in 1896 the Italian efforts were suspended and Cyrenaica was left again to the Arab and the Turk.

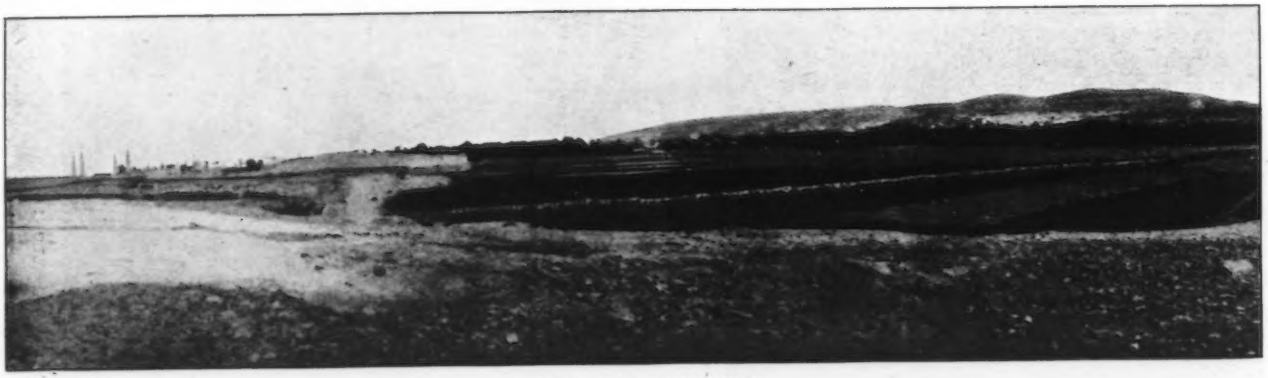
II. The Ito Expedition of 1908.

About ten years later Cyrenaica attracted attention as a suitable home for the oppressed Jews of eastern Europe. The immediate acquisition of Palestine by the Jews was clearly impossible, but Cyrenaica might serve as a temporary land of refuge; and a successful Jewish settlement there might lead, if political changes should weaken the Turkish hold on Palestine, to a refulfilment of the prophecy of Obadiah that Jewish exiles from Sepharad (Cyrenaica) should reoccupy the cities of southern Palestine.

The Turkish administration in Tripoli was prepared to welcome a Jewish colony; so I was asked by the Council of the Jewish Territorial Organization to organize an expedition to Cyrenaica to investigate the suitability of the country for an extensive Jewish settlement. Our party consisted of Mr. M. B. Duff, of the firm of Messrs. Middleton, Hunter & Duff, as expert on water-supply and engineering; Dr. Trotter as expert on north African agriculture; Dr. Eder as doctor and to report on the healthiness of the country; and we were accompanied by Professor Nahum Slousch of the Sorbonne, who is intimately acquainted with the long history of the Jewish connection with Cyrenaica.

We first visited Tripoli to meet Redjeb Pasha, Governor-General and Commander-in-Chief of Turkish Africa. The letters of that enlightened and high-minded official enabled us to visit the country under much freer conditions than were usually permitted; for he was anxious to advance the development of his province, and it was hoped that a Jewish settlement would prove an extra obstacle to the dreaded Italian seizure of the country.

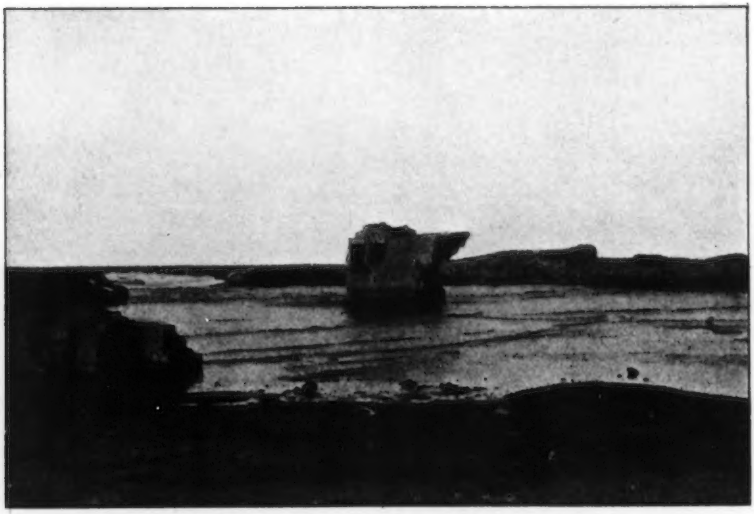
From Tripoli we crossed the Great Syrtis, and near Tocra had our first near view of the Cyrenaican plateau, and of the hanging valleys which notch its edge. We landed at Derna, the chief town between Benghazi and Egypt. The importance of Derna is due to the permanent stream which flows from two springs in the Wadi, and is used to irrigate the



DERNA FROM THE WEST.

THE NORTH-EASTERN NECROPOLIS OF CYRENE.

WADI DIMI-ELL WEST OF MARSA-SUSA



RUINS OF ROMAN QUAYS AT APOLLONIA.

delta. We engaged a house on the bank of the river, hired camels and drivers, and were allotted an escort from the Turkish garrison. While organizing our caravan we made excursions through the irrigated gardens on the delta, to the water-mill built during the American occupation of the town in 1805, to the ruined Roman aqueduct; we also visited the deep Wadi Derna to inspect the rocks exposed in its cliffs and the springs at Seghia and Bonmansur which maintain the permanent flow of the stream; and we crossed the hills to the east to observe the nature of the land on that side of Derna, and determine the relations of the plateau to the coastal plain at its foot.

During these excursions we found the site of a palæolithic camp on the floor of the Wadi Derna, and examined the Gasr el Harib, a megalithic ruin on the plateau. Mr. Duff measured the discharge from the two springs in the Wadi and found they were then yielding six million gallons a day. (Photographs of the adjacent waterfall show that the flow over it is sometimes much greater than it was then.) The springs rise near a step across the valley which has been formed by a bank of calcareous tufa, and the upper stream falls over its corniced terraced front. Thanks to these springs the town of Derna is a garden city, but from the edge of the irrigated ground it is only one step into the desert.

I was anxious to go eastward in order to see the nature of the country between Derna and Egypt; but that district was closed to Europeans as the Sultan feared that any accident to a traveller amongst its turbulent Arabs would be used as the excuse for the annexation of the country to Egypt. I had pledged my word to Redjeb Pasha that we would not go further east than we could manage in a single day's excursion from Derna. So when our caravan was ready we turned westward to march overland to the port of Benghazi, the ancient Berenice, the chief town of western Cyrenaica. Our visit was in summer, at the end of an unusually dry season; so water was scarce and we had to trust to camel transport. This season of the year was the most suitable for our purpose, as it would have been impossible during the rains to have estimated the permanent water-supply of the country.

Leaving the gardens of Derna we marched westward along the coastal plain between the plateau and the sea over dunes of calcareous sand and low hills of limestone. Our first camp was beside a dry wadi and a deep well which had been sunk almost to sea-level. To our surprise and disappointment the well was absolutely dry, showing that the rocks are sometimes completely drained to sea-level, and that wells sunk below it would probably soon become brackish by sucking in water from the sea. Next day we climbed by a steep track on to the plateau; the rocks near the foot of the cliffs included a soft white limestone, whose resemblance to chalk is increased by nodules and layers of flint. This bed was covered by varied limestones, but I searched in vain for any beds of clay which would uphold water and thus provide useful wells. The surface of the plateau is

a gently undulating moorland, with some thin woodland and evergreen scrub; there are extensive areas of bare limestone; and the best land consists of sheets of limestone waste in the hollows. We followed generally the line of the old Roman road to Cyrene and frequently saw well-preserved wheel-ruts made by the ancient traffic; and as they have doubtless been exposed since Roman times they indicate that the climate has never since their formation been wetter than it is at present; for if these ruts had been often occupied by runnels of water they would long ago have been washed away.

In the first part of the journey over the plateau wells were fairly frequent, and we passed near some considerable settlements around the monasteries of that strict religious order, the Senusi, which has already exercised great influence throughout Mohammedan Africa.

Journeying westward the plateau rose gradually from the level of 1100 to 1800 feet; its undulations became gentler and the vegetation scarcer; near Cyrene we followed the ruined aqueduct which carried water to the city from some Roman reservoirs which had been excavated in a limestone hill at Safsaf. We turned aside to visit them and found them quite dry. Dr. Trotter's measurements show that they had a capacity of one and a half million gallons; and as the Romans thought this small quantity worthy of a 7½-mile aqueduct water must have been a precious commodity.

Our next camp was beside the famous Fountain of Apollo at the site of the ancient city of Cyrene. This was the most attractive locality we saw in Cyrenaica. The Fountain of Apollo discharges through a cave on the upper face of the plateau, beside some large olive trees; and the stream rushes in a foaming brook down the cliff on to a terrace where its water is used in cultivation. From the edge of this terrace a lower cliff falls abruptly to the shore. The ancient port of Cyrene was 12 miles distant, at Apollonia or Marsa Susa. Mr. Duff and I devoted two days to an excursion there, to observe the general nature of the route and estimate the cost of reopening the port and connecting it with Cyrene by a light railway.

The descent to Marsa Susa is of great beauty. The road winds down over successive limestone terraces, passes through some thin forest, and commands one magnificent view down the canyon of Wadi Dimi-ell. It then descends steeply to a narrow plain between the dissected front of the plateau and the sea. The old piers at Marsa Susa indicate that the land stands at almost, if not quite the same level as in Roman times, though the harbour has been altered by silting. The only fresh water at the time of our visit was a spring, an hour and a half's distance up the wadi; and the commandant told me that there was then not a single resident along the coast route between Marsa Susa and Derna. Marsa Susa was occupied by fifty-five families, mainly Cretan refugees, who raise crops of cotton, onions, barley, wheat, maize and beans.

We were charmed with the beauty of Cyrene and deeply interested in its classical remains, including the ruins of the scattered limestone villas which have been described as marble palaces, the city walls, the amphitheatre, and the Necropolis in which the tombs have been quarried out of a soft Nummulitic limestone on the upper face of the plateau. We would gladly have remained longer; but we made only a brief stay, for we were disappointed with the economic possibilities of the locality. Mr. Duff's measurement of the Fountain of Apollo showed that its discharge was a paltry eighty-four thousand gallons a day. The Arabs said, no doubt correctly, that its flow was fairly uniform throughout the year and that it had been steadily failing since Europeans had visited the country. The decline was probably due to the succession of dry seasons from 1896 to 1908.

No doubt more use could be made of the water if the night and winter flows were stored; but the total volume from all the springs in this locality would not serve for any extensive irrigation, and the area irrigated in Roman times was apparently small.

The total water-supply of Cyrene at the time of our visit would have given about ten gallons per head per day for 18,000 people, not allowing any for irrigation or domestic animals. The Romans supplemented this supply from the reservoirs at Safsaf, which would have given a gallon a day for three months to 15,000 people; and the fact that the Romans went so far for so small a supply indicates that the springs at Cyrene were probably not more prolific in Roman times than they are at present.* As Cyrene offered no opening for any considerable agricultural population, and the limestones were too porous for large storage reservoirs, we thought it best to hurry on in the hope of finding more suitable localities.

We had so far marched along the northern edge of the plateau where the rainfall is heaviest, the land most fertile, and the trees and vegetation most abundant; and probably most of the inhabitants were then collected in that belt owing to the scarcity of water elsewhere. It seemed advisable to examine the conditions further back from the coast. Our escort objected to this project, owing to danger from the Arabs and the lack of water. So we agreed that the main caravan should continue along the northern road, while Dr. Eder, Mr. Duff, and myself, with a couple of

* The population of Roman Cyrene has been estimated as high as 100,000. This amount seems to me excessive in consideration of the available water-supply. The amphitheatres, of which there are three, possibly belonging to different dates, are each, according to the plans of the Beecheys and Smith and Porcher, about 200 feet across. The large temple near the Stadium, according to Smith and Porcher's measurements, has an internal measurement of 100 feet by 50 feet. The size of these structures suggests that the city of Cyrene at its best had a comparatively small population. The area within the city walls is about one and a quarter million square yards. At 50 square yards per inhabitant, a rate which has been often adopted for Eastern cities but would probably be too low for Cyrene, the population would be about 25,000. The various methods by which I estimated the ancient population gave results varying from 15,000 to 25,000.

Turks, made a rapid excursion south and rejoined the others at the wells of Messa.

To lessen the anxiety of our nervous escort we discarded our pith helmets and used the red fez, so that they could pass us off as Turkish officials. I heard afterwards that I had been represented to the Arabs as a Kurdish cavalry pasha as my ignorance of Arabic was thus explained. As we rode southward the level gradually rose; we left behind the trees and green gardens of Cyrene, and crossed brown rolling downs which were littered with stones and outcrops of brown-stained limestone. For hours the most conspicuous feature in the landscape was the rounded cupola of the shrine of some holy hermit, and we felt that we had passed from classical Cyrenaica to the home of the Bedouin. Some figures and the head of Jupiter Ammon carved on the limestone beside the well at Slonta showed that the Romans had a station here, for it was on the southern road through Cyrenaica. From the hillside above the wells we looked southward over vast treeless rolling plains, which so far as we could learn from the Arabs, descend gradually southward, though the maps represent the plateau as bounded on the south by a steep descent to the plains from Siwah to Aujila (see Sketch-map, Fig. 1).

The Slonta wells contained little water; we had heard that many Arabs were assembled around the wells, but we saw only two or three who were living in tombs excavated in the hillside and were tending some flocks of sheep. The Arabs told us that most of the people had withdrawn with their cattle to the better-watered region in the north.

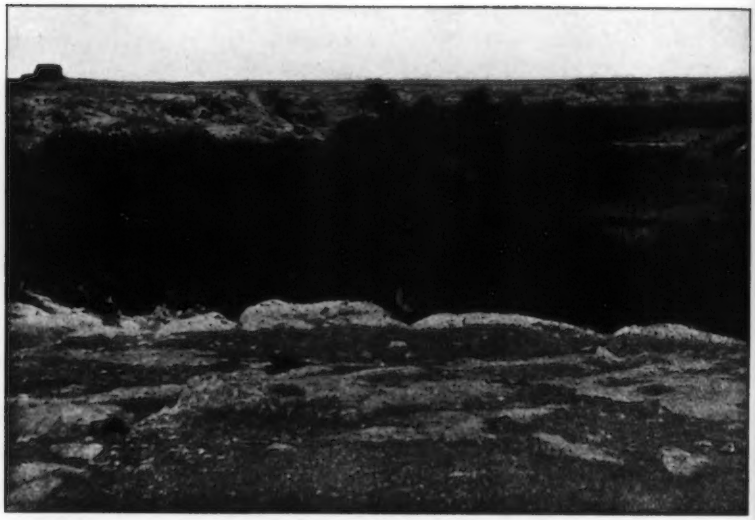
At Slonta we turned north-westward and passed one of the best-preserved Roman castles near the head of the Wadi Khumas. We descended that valley, which deepened to a picturesque wooded canyon, and found on its floor evidence that it has been occupied by a stream several feet deep; but that there had been no flow down the wadi in recent years was shown by some banks of loose debris which had collected across the stream-bed. Climbing again on to the plateau we rejoined the northern road by the wells at Messa, which now, as in classical times, is one of the most important centres in the country. The wells are prolific, and a Turkish detachment and a considerable assemblage of Arabs were camped beside them. We were at once given permission to take as much water as we required.

While at Messa I searched for a reported "Stonehenge," which proved to be a part of a Roman aqueduct. The country contains many large standing stones and trilithons, which have been accepted by Barth and later authorities as megalithic; but most of those I saw had been worked by metal tools and probably date from Roman times. The stone circles of the Gasr-el-Harib to the east of Derna appear however to be pre-historic and megalithic.

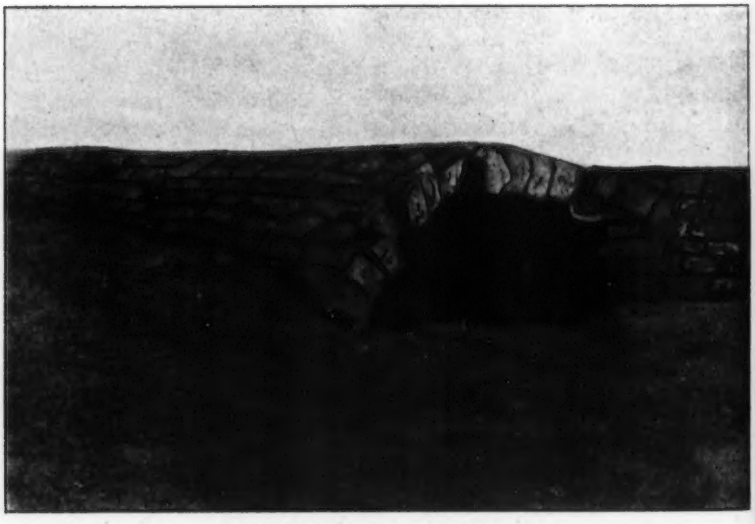
From Messa, after loading our camels with as much water as we could carry, we continued westward along the main road to Benghazi. We soon

CARVED FIGURES ON ROCK FACE AT SLONTA.

FOUNTAIN OF APOLLO AT SHIAHAG.



GARDENS OF THE HESPERIDES.



GREAT RESERVOIR AT SAFSAF.

had to descend into the valley of the Wadi Jeraib, about 600 feet deep (this ravine appears to be the outlet from the Wadi Jeraib, which is usually represented as a basin without an outlet); growing on its floor are the finest trees we saw in Cyrenaica, some groves of tall cypresses. We climbed again on to the plateau by a track once guarded by a ruined castle, the Gasr el Migden, the most conspicuous Roman building in the country. Thence our way continued over limestone moorlands, sometimes covered with scrub, and in places, as at the Wadi Argub, hollowed

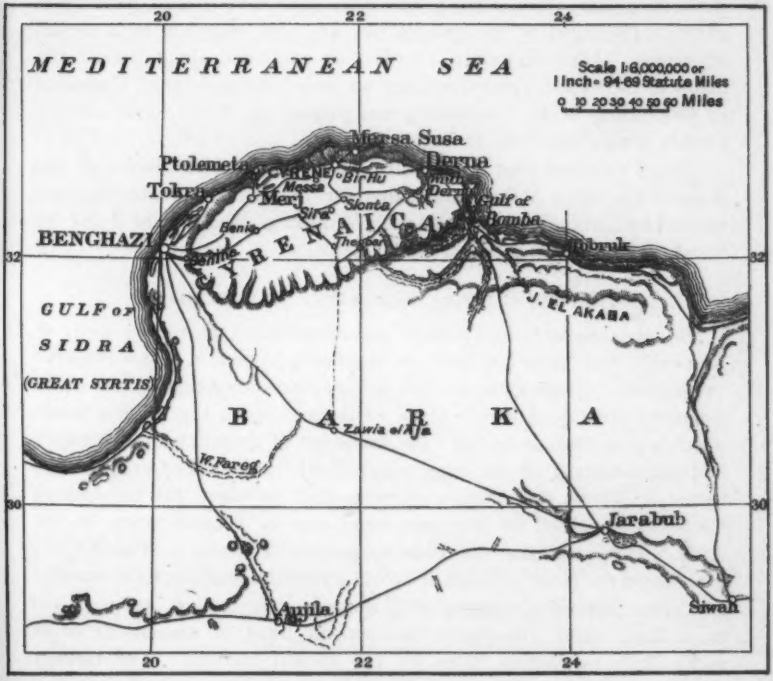


FIG. 1.

into flat-floored basins, the soil of which, if adequately watered, would doubtless prove of great fertility. The wells, reservoirs, and watercourses that we passed were all dry; but most of the cultivable land showed traces of cultivation; some patches of soil, only a few yards in area, lying in hollows in the limestone are tilled by the thrifty Arabs.

We traversed one belt of low forest and that evening reached a well in the Wadi Gharib where, after some trouble, we were allowed to replenish our water-bags. The night was noisy owing to the quarrel between the natives camped at the well and some strangers who had driven their cattle there for water, which for a while was angrily refused.

Next day we reached the Turkish fort at Merj, the ancient Barca. Its garrison controls the plains of Merj, which, with their continuation westward along the route to Benghazi, form the best considerable tract of cultivable land that we saw. These plains, 160 square miles in area, occupy a series of basins at the foot of a long fault scarp. They are probably all tilled by the Arabs in suitable seasons and with the intervals necessary in their primitive system of agriculture.

From Merj we made a branch excursion to the sea at Ptolemeta, descending from the plateau to the shore down a very steep, picturesque gorge. The ruins of the ancient city are now occupied by a Senusi settlement. After our return to Merj we continued along the alluvial plains to the west. Three days later we ended our traverse of Cyrenaica by descending to the coast plains and passing the River Lethe and the Garden of the Hesperides to Benghazi.

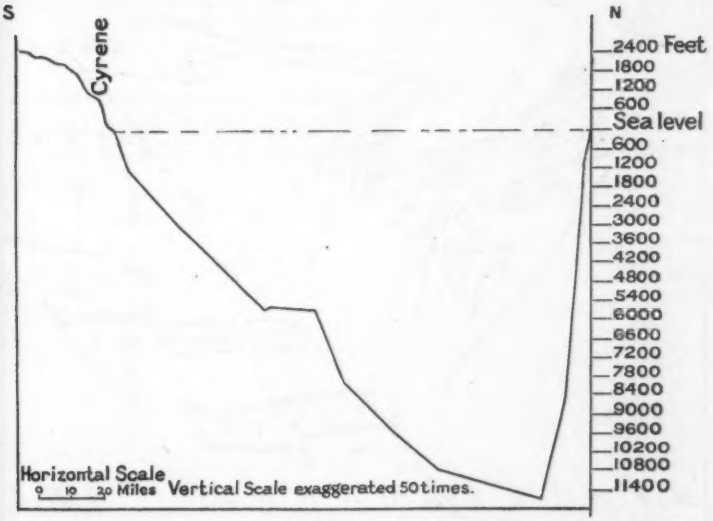
There we found that during our journey the Turkish revolution had deposed the Sultan Abdul Hamid, that our friend Redjeb Pasha had been recalled to Constantinople as Turkish Minister of War, and next day we heard of the irreparable tragedy of his death.

III. The Economic Geography of Cyrenaica.

(*a*) *Its Geographical Relations and Structure.*—Our special study in Cyrenaica was concerned with its economic geography, which involved preliminary consideration of its geology and physiography, of which singularly little was known. Della Cella had collected at Cyrene fossils which he described as having "the characters of ammonites" (this record is doubtless based on the large nummulites); and as they are common fossils in Algeria and Tunis they supported the view that the core of Cyrenaica consisted of Mesozoic rocks and is a continuation of the Atlas. This conclusion has been supported by Sir R. L. Playfair and it appeared the more probable since the crystalline marble of the statuary at Cyrene has been represented (Camperio, 'Esplor.,' **6**, 1882, p. 16) as a local rock. We found however no trace of ammonites or of rocks likely to contain them, or any ancient marbles. The country along our route consisted entirely of Kainozoic limestones, similar to those found in Egypt and Malta; and from their general horizontal position the same rocks probably constitute the whole of the Cyrenaican plateau. The country in fact appears to consist of one block of limestones which, though occasionally tilted, are usually nearly level. The limestone plateau is bounded to the north and west, and probably also to east, by great faults, by which its former continuation has foundered beneath the Mediterranean. The nature of the descent eastward to Egypt is still uncertain; but the Jebel Akbar, the "Abrupt Hills" to the east of Derna, and the adjacent coast are traversed by many conspicuous north and south lines which indicate that the main features in the topography of these hills are due to fractures. Clear evidence of great

faulting is also afforded by Crete, across the deep trough to the north of Cyrenaica (see Fig. 2). The faults no doubt belong to the same series as those which in recent geological times (upper Miocene to Pleistocene) broke up the land which extended from Cyrenaica to the Balkans, formed the Ægean Sea and its archipelago, and fractured Greece (see Sketch-map, Fig. 3). The southern margin of Cyrenaica is the Siwah-Aujila valley, which in places descends below sea-level; according to most maps the plateau ends abruptly against this valley.

Cyrenaica is therefore a great horst. It is also a karst-land, that is a highland composed of limestone. Its water-supply is also deplorably



SECTION FROM THE PLATEAU S. OF CYRENE TO CRETE

FIG. 2.

limited. So Cyrenaica may be briefly described as an arid, karst-land horst.

(*b*) *Water-supply.*—That Cyrenaica consisted largely of limestone we fully expected; but we had hoped to find interbedded with the limestones layers of clay, which by holding up the water would maintain abundant wells, and also be useful for the construction of water-collecting surfaces and reservoirs. The amount of impermeable rock in the country is however very small. The limestones are several thousand feet in thickness, and among them are some beds of clayey limestone which act as relatively impermeable layers and form the springs at Cyrene. The country as a whole is, however, so porous that most of the rain soon sinks below the surface and escapes to the sea and to the low-lying southern oases through

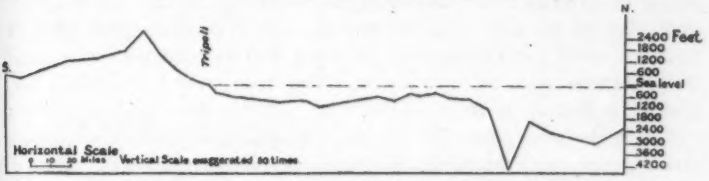
deep underground channels. The depth of these buried channels is shown by the fact that even wadis 700 and 900 feet deep had, during our visit, no springs upon their floors.

Sketch Map showing
THE RELATIONS OF THE FAULT LINES OF CYRENAICA
TO THOSE OF THE AEGEAN
The faults in Greece are reduced from the maps of
Lepsius, Philippson, Deprat &c.
Fault lines thus ———— Dotted areas in Greece are
sunklands and rift valleys.

FIG. 3.

The water-supply of Tripoli, although the country to the south of it is low and arid, is more abundant than in Cyrenaica, where immediately

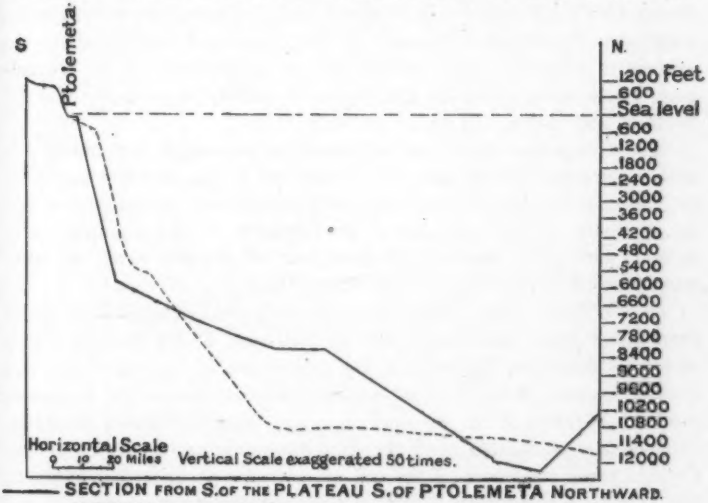
behind Ptolemeta and Marsa Susa the hills rise to the height of 2000 feet. Tripoli is built upon a series of silts and sands which absorb the water that pours into the oasis after rain; and these beds have no free drainage, for the adjacent sea shelves gradually northward so that the depth is only 100 fathoms at 120 miles from the shore (see Fig. 4). The impermeable sea



SECTION FROM S. OF TRIPOLI AND ACROSS THE DEEP TROUGH NEAR MALTA.

FIG. 4.

floor holds the water back, and nearly all that reaches the sands can be obtained from the numerous prolific wells. On the Cyrenaican coast on the other hand the sea floor sinks rapidly and sometimes (Fig. 5) to the



——— SECTION FROM S. OF THE PLATEAU S. OF PTOLEMETA NORTHWARD.
- - - - - SECTION FROM BENGHAZI NORTH-NORTH-WESTWARD, AFTER THE SECTION BY LUKSCH AND WOLF, PLATE VI.

FIG. 5.

depth of 1800 fathoms only 60 miles from the shore. On so steep a slope the floor deposits are probably thin, and as the lower water may be under the pressure of a column 1000 feet high, it is doubtless forced into the sea, and in dry seasons lies in the rocks at depths inaccessible by ordinary wells.

The amount of the water which can be obtained in Cyrenaica depends directly upon the rainfall, which has been often regarded as over 20 inches a year. This estimate appears unduly optimistic. Knox in his 'Climate of Africa' reports the rainfall of Tripoli as 18·58 inches for the years 1892–95; and he quotes from Supan the average of 13·64 inches for the period of 1879 to 1892. According to Knox the average for Benghazi from 1891–99 was only 11·94 inches. Records at Benghazi from 1891 to 1904, for which I was indebted to Dr. Shaw, give the rainfall as an average of the thirteen years as 10·56 inches. They have been reprinted by Mr. Duff ('Ito Report,' p. 46). Eredia, 1912, p. 63, quotes 282·1 mm. (11·1 inches) as the mean from 1891 to 1905. The Benghazi records relate to a period during which the rainfall was probably somewhat below the average.

A heavier rainfall has been claimed from Cyrenaica on the ground that there is so great a discharge of fresh water to the sea that the water along the Cyrenaican coast is abnormally fresh. This claim, if substantiated, would certainly encourage the hope that the rainfall is much heavier than is shown by the available rainfall records; but it is not supported by the report of Luksch and Wolf (1892, pls. xxi.–xxiv.) on the observations made during the Pola Expedition in 1890 and 1891. Their maps of the eastern Mediterranean show that the water on the Cyrenaican coast is above the average in saltness. Their conclusions are represented in the Sketch-map, Fig. 6, which shows the distribution of salinity on the surface, at the depth of 100 metres, and on the sea floor.

The Cyrenaican rainfall occurs mainly in the winter, and much of it falls in torrential storms; and this distribution is the most favourable for the collection of water in reservoirs, the method which we assumed would be necessary for the agricultural development of the country. For ordinary agriculture, however, the same amount of water would be more useful if it fell in gentler and longer spring rains.

(*c*) *The Soils.*—That the Arabs are able to produce much corn under the adverse local conditions is due to their skill in dry farming. This method is sometimes referred to as if it meant farming without water; but even in Australia, where the conditions are unusually favourable, an annual rainfall is required of not less than 14 inches, though ultimately it may be commercially practicable where the rainfall is as low as 10 inches. But in Cyrenaica the conditions of the soil are in many places unfavourable to this system of agriculture. The soils are scanty in consequence of the exceptional purity of the Cyrenaican limestones. As these rocks weather, most of their material is dissolved and very little debris is left behind. Accordingly the weathering of the rocks produces comparatively little soil, and the particles are light and fine grained, and they are easily removed by the wind. Hence the country includes an unusually high proportion of bare rock and its soils are thin and scanty. The soils themselves are no doubt of excellent quality. As Dr. Trotter remarked in the 'Ito Report,' they belong to the class of soils the most prized by

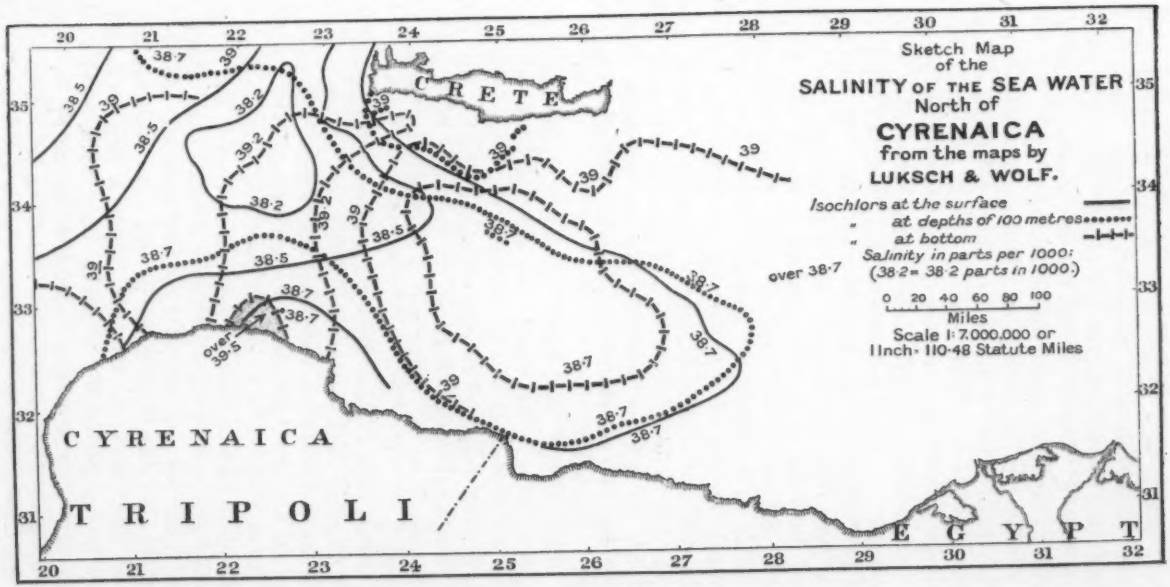

Sketch Map
of the
SALINITY OF THE SEA WATER
North of
CYRENAICA
from the maps by
LUKSCH & WOLF.
Isochlors at the surface
" at depths of 100 metres
" at bottom
Salinity in parts per 1000:
(38·2 = 38·2 parts in 1000.)
over 38·7
0 20 40 60 80 100
Miles
Scale 1:7,000,000 or
1 inch = 110·48 Statute Miles
CRETE
CYRENAICA
TRIPOLI
EGYPT
20 21 22 23 24 25 26 27 28 29 30 31 32
31 32 33 34 35

FIG. 6.

agriculturists. They are light, easily worked, calcareous soils. They are rich in the mineral plant foods; for example the average of phosphoric acid in thirteen analyses by Dr. Trotter is 1·5 per cent. Owing to the hot dry summer they are naturally poor in nitrogen. Their chief defect however is in quantity. They are usually thin and often lie in small patches surrounded by exposures of hard bare limestone.

(*d*) *Conditions of Deposition of the Cyrenaican Limestones.*—The lack of coarse-grained sediments in the Cyrenaican limestones is surprising, since the collection of deep-sea deposits by the *Pola* shows that even in the deepest parts of the Levant and eastern Mediterranean the sea floor is strewn with abundant grains of quartz, felspar, hornblende, zircon, and other minerals. As Windt and Berwerth have remarked (1904, p. 294) much of the material must have come from old rocks. Sir John Murray's report on the "Deep Sea Deposits" of the *Challenger* (1891, Chart I.) represents the whole of the Mediterranean as floored with terrigenous deposits or sediments derived from the lands. During the formation of these Cyrenaican limestones the continental rocks of northern Africa were probably exposed on land less than 200 miles south of Cyrene. I therefore expected a larger quantity of mechanically formed sediment in the rocks than we found. In one or two layers we saw quartz pebbles; but as a rule the rocks are remarkably free from terrigenous material—a fact confirmed by a microscopic study of these limestones kindly made by Mr. D. P. McDonald.

The explanation of the unusual poverty of these limestones in mechanical sediment is that though they were deposited near land no great rivers then discharged into the sea along this coast, so that the sea floor was covered mainly by materials of organic origin. The contrast with the abundant terrigenous fragments on the bed of the adjacent sea shows how recently the floor of the eastern Mediterranean has sunk to its present depth.

(*e*) *The Rainfall in Classical Times.*—The present disappointingly low rainfall of Cyrenaica suggests that it must have been heavier in classical times, and that conclusion has been advocated by many authorities, such as Fischer and Elsworth Huntington. During the Glacial period of Europe northern Africa no doubt had a better rainfall than at the present time, for the European cyclone track lay further to the south, and the north African coastlands must have received more abundant rain. During this period the Dead Sea was covered by a fresh-water sea, and powerful perennial rivers in Cyrenaica excavated its deep wadis, which had attained their present depth before the advent of Palæolithic man. Although the assumption of a greater rainfall in classical times would afford a simple explanation of the then flourishing condition of the country, the evidence is overwhelming that the "pluvial period" ended long before historic times, and that the Greek colony of the seventh century B.C. found Cyrenaica with a climate essentially the same as prevails to-day. The classical

records show that the country produced the same crops as it does now; it was mainly famous for its cereals, and its most valuable present export is the dry hard barley which is sent to Scotland for the manufacture of whisky. The other chief products were wool, oil, and an extract from the much-debated herb, the silphion, which is generally thought to have been deliberately exterminated in ancient times. The country was liable then as now to long periods of drought, which caused terrible famines. The arid climate of the country to the south is indicated by the abundance of locusts, from which the country was usually saved by laws enforcing the systematic destruction of the eggs and young; sometimes these regulations proved ineffective and the country was devastated by plagues of locusts, which led to famines and pestilence.

The general geographical similarity of the classical and present conditions is shown by the descriptions of Strabo. According to his account the tree belt was 100 stadia or a little over 11 miles wide, and it was succeeded to the south by another 100 stadia where the land was sown but from excessive heat did not grow rice; further south the country was very sterile and dry, and Aujila was even then an oasis in the desert. Strabo reported that when Marcus Cato marched from Benghazi (Berenice) round the Syrtis, his army "of more than 10,000 men separated into divisions on account of the watering-places; his course lay through deep sand under burning heat." Strabo's account of the zones of vegetation in Cyrenaica and of the condition of the country to the south would apply well at the present time; so that any serious change in the climate since his day is improbable.

Direct geographical evidence confirms the historic records. In Roman times the chief settlements were all around the existing wells, which were then as all-important politically as they are to-day. The port of Ptolemeta had no well and was dependent on an aqueduct. The soil over the Roman ruins is a light loam which was doubtless deposited under similar conditions of moisture to those that prevail at the present time. The abundance of the Roman waterworks show the intensity of the struggle with drought, and that the water-supply was the limiting factor in the progress of the country.

(*f*) *Cause of the Contrast between Classical and Modern Conditions.*—If then the climate of Cyrenaica has not changed, what is the explanation of the contrast between its past and present conditions? Many travellers, recollecting its classical importance and charmed by the beauty of its scenery and the verdure on its limestone hills after rain, have been led to exaggerate its fertility and blame the Turks for the modern state of the country. But the Turks have only held it for seventy years, and since 1835 they have done far more to improve it than has been generally recognized. They have improved the roads, introduced the telegraph, and established garrisons which have kept peace between the turbulent Arab tribes. The Turkish administration and the influence of the Senusi have led the

Arabs to adopt a more settled life, to the extension of the growth and export of corn, and to a great increase in the size and prosperity of the ports. The treelessness of the country, despite a well-known saying, is not the fault of the Turks, for most of Cyrenaica was treeless in the time of Strabo.

The fact that the country is now of secondary commercial importance is due to changes over which the Turks had no control. Its chief products corn and wool have become less profitable owing to the competition of the extra-European countries, and its honey has been superseded by the sugar-cane and beet-root. In recent years the Trans-Saharan trade, which had an annual value of between two and three million pounds in the middle of last century, had declined to less than half a million by the end of the century owing to the diversion of the Sudan trade by railways to the Niger and Nile. Further the development of steam navigation has deprived Cyrenaica of its strategic importance on the great north African land route.

The conclusion that Cyrenaica has no connection with the Atlas Mountains but is a western outlier of Egypt undermines the hopes based on the frequent comparison of Cyrenaica with Morocco, Algeria, and Tunisia. Those countries are traversed by the Atlas Mountains which rise to 14,750 feet in height; they have a rainfall varying from 20 to 40 inches, and in many respects they are European rather than African. Thus biologically they are united with Europe and placed on a distinct zoological region from the rest of Africa. Tripoli and Cyrenaica on the other hand are typically African. The position of the city of Tripoli corresponds not with Algiers but with Biskra, for they are both oases on the edge of the Sahara. Cyrenaica has no folded mountain range and has not the varied rocks and valuable minerals of the Atlas. As regards mineral wealth it must be compared with Egypt, for it is really part of its uplifted western margin. And Cyrenaica is an Egypt without the Nile.

(*g*) *The Future of Cyrenaica.*—The decline of Cyrenaica may be explained by the land having lost its former strategic and commercial importance owing to changes in the main trade routes and to its products having been superseded by the opening of the prolific trans-oceanic lands. The improvement of the country is therefore a more hopeful task than if it had been ruined by an irremediable climatic change. The expectation of Senator de Martino (1908, p. 65) that Italy will find Cyrenaica "an inexhaustible fountain of richness" appears too sanguine, though the view that the country is all a useless desert is equally extreme. My report of 1908 may easily be regarded as more unfavourable than was intended. The country seemed to me unsuitable for a refugee colony since, instead of being practically unoccupied, it has a considerable population of turbulent Arabs; and they would fiercely resist the appropriation of their best land and the control of the coast through which pass the arms and ammunition for the Senusi and their allies in the Sahara and the Soudan.

It does not follow that because the country proved ill fitted for a Jewish settlement it is an undesirable possession for Italy, which being willing to spend £100,000,000 on its conquest, should not grudge a few millions for the necessary water-supply works, roads, railways, harbours, and afforestation.

The development of the country will be a most instructive experiment, which Italy can undertake with the best prospects of success; for she is near at hand, has a deep sentimental interest in this old Roman province, and an overflowing population of peasants who are skilled in cultivation of the olive, which is probably the most profitable product Cyrenaica can grow at present.

The difficulties in the way are that Cyrenaica is a high limestone plateau, which has low winter rains and no summer rain. And the possibilities of such country may be appreciated by comparison with other Karst-lands around the Mediterranean. The Karst-lands had many attractions in mediæval times; for they were healthy, productive, and easily defended. Under modern conditions they have declined in value and importance. The Adriatic Karst-lands have many advantages over Cyrenaica; for they have a heavier rainfall, a cooler climate, and a magnificent position between a rich populous hinterland and an important coast which is provided with numerous excellent harbours. Nevertheless Montenegro is poor and sparsely peopled, while Dalmatia and Herzegovina have not repaid the money and care Austria has devoted to their development.

It is still too soon to judge Italian progress; but since the conquest of Tripoli Italian literature and maps (for example, 'Map Nuove Province Italiane. Tripolitania e Cirenaica.' Published by Istituta Geografico de Agostini. Novara, 1912) of the country show that it is now generally recognized that Cyrenaica is not a colonial paradise, and that expenditure upon it may give a better political than commercial return. We have no reason to regret that Italy has undertaken this task. It was one of her first long steps toward withdrawal from the Triple Alliance, and the establishment of this colony between the French possessions and Egypt must tend to link Italy with France and Britain. Progress in Cyrenaica will probably be slower than in Algeria, and in Egypt; but we can watch it with sympathetic interest, and feel grateful to any Power that will help in the pacification and development of the long derelict lands of northern Africa.

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The PRESIDENT: Prof. Gregory is very well known to us all. We know him as a traveller who has often come before us to give us the results of his journeys. He has wandered in many parts of the globe, from Spitsbergen to the centre of Australia. He has visited the Rift Valley of Africa, and from wherever he has been he has brought back valuable results, geographical as well as geological. To-night he is going to talk to us about a country which has a special interest at this moment—Cyrenaica, the eastern wing of Tripoli, which the Italians conquered four years ago, and which is now, unfortunately, one of the many seats of war on the face of the globe.

(*Prof. Gregory then read the paper printed above and a discussion followed.*)

Mr. HOGARTH: I have listened to Prof. Gregory to-night with the same admiration for his clearness of statement and sureness of touch as I felt four or five years ago when reading the report which he presented to the Jewish Territorial Organization after his return from Cyrenaica. To-night, as then, I have agreed entirely with his conclusion, though not with all the reasons with which he supported that conclusion. The country is manifestly not fitted for settlement by the kind of colony which the Jewish Territorial Organization wished to place there, and for which it wishes to find some room or other in the world. I thought then, however, and on hearing him again to-night I felt, perhaps not quite so strongly, that Prof. Gregory had taken a rather excessively bad view of the aridity of Cyrenaica when he was there. He passed through the country in August, the hottest and worst month, and I fancy that, though the Turks—represented then by Ragheb Pasha, who was afterwards killed—were very anxious that Jews should settle there, the local Arabs, who are a singularly truculent lot well armed and not fond of strangers, were by no means so anxious that he should see the best of Cyrenaica. I have not seen much of the country myself, but I have seen more water, at any rate at an earlier season of the year, than will justify Prof. Gregory's low estimate of the supply of the country; and a great many photographs taken by the American expedition, which was there a year or two later, show a fertility on the limestone plateau very different from those which he has shown on the screen.

There was one class of argument used by Prof. Gregory which I may be allowed to mention, since it occurs in the paper as it will appear in the *Journal*, and that is the argument from (or rather against) antiquity. It is stated on what is singularly good authority that the city of Cyrene had a population

of over 100,000 persons. Prof. Gregory does not believe this. His estimate for the population which inhabited these extensive ruins is at the outside about 25,000. May I recall to your memory ancient Attica? There is extraordinarily good evidence for its population. We have a Greek census which is supported by the returns of corn imported into the country. It shows that Attica was inhabited by just upon half a million people. Nowadays it is inhabited by a smaller population, which finds the water-supply too little. Why is that? Simply because it is a quite different population, being now all free. In antiquity it was a population in which there were thirteen slaves to every free male citizen, and something like ten slaves to every free person. In fact, in antiquity, you have to allow not only for the possibility of life under very much less pleasant circumstances (that is to say, for a population which will subsist on very much less water than nowadays), but for one also which huddled together much more closely than a modern population. I would venture to suggest that Prof. Gregory's argument, not only from the comparatively small supply of water, but also from the smallness of temples and the comparatively small sites of ancient cities, is not really sound. An ancient temple was not a congregational building at all. Very few of the people who worshipped at a temple entered it. Many of the most famous of ancient temples were among the smallest. As for sites, all I can say is that I have seen a very great many ancient sites, and there is none I have ever seen which impressed me more than the site of ancient Cyrene. I should be quite prepared, upon the mere view of the site, to accept that ancient estimate of a population of about 100,000.

These are, however, rather academic questions. I will only repeat that from my own experience I quite agree with Prof. Gregory's conclusion that Cyrenaica is not a country for Jewish colonists. Although there is a good deal of fertile land, it is restricted, and it is very thickly inhabited now as such countries go. The population in possession is a very vigorous and by no means very small one. That population would have shown itself extremely hostile to such a body of colonists as the Jewish Territorial Organization proposed to put there. Those colonists are drawn from a very worthy population, but one which as a general rule is town-bred. The Jews who wish to leave their native cities are very often of the small shopkeeper class which is not at all accustomed to breaking up rough country, and would find it difficult to make head against such Arab tribes as range Cyrenaica, every man of whom is armed with a breech-loading rifle, and in these days has often been trained into something like the semblance of a regular soldier. The Turks once tried to put in a body of Kurds there, but failed. The truth is that they have always had considerable trouble with Cyrenaica, even as with the country beyond Jordan where they have settled Circassians to pen back the Arabs, who had long been raiding into Palestine and rendering the lives of the settled inhabitants of that country a burden.

I hope I have not done Prof. Gregory an injustice by the few criticisms I have passed. I am not quite sure that that argument about the ancient population was not contained in the Preface to the Report supplied by Mr. Zangwill, rather than in the body due to Prof. Gregory. I can only say how glad I was to read that Report, and to see that a party of scientific men, who could state their results with scientific accuracy, had gone into a country which up to a year or two ago was singularly inaccessible to Europeans, and, I am afraid, since the falling back of the Italians to the coast, has become almost as inaccessible again.

The PRESIDENT: In the absence of other speakers, I presume I must add the few words I can on a region of which I have no personal knowledge. In the first place I am glad to hear from Mr. Hogarth that there is something to be said for the scenery of Cyrenaica. For I confess I was blushing deeply for the travellers who had compared it to the choicest portions of Switzerland. They are, however, dead; but I wish Mr. Weld Blundell, who is alleged to have said that at times in Cyrenaica he could not believe that he was not in an English park, were here to justify his opinion. I should like to know where those sylvan retreats are to be found.

One of the most striking vicissitudes in the world's history is the way in which in modern history North Africa has been disconnected from Europe. In olden times the Midland Sea served as a link between the countries surrounding it. After Carthage fell the Romans crossed to the lands south of Sicily, and built the cities of which we still see the imposing remains, the streets, the noble columns, and the vast amphitheatres. And before the Romans, about 600 B.C., the Greeks had passed across to the promontory of Africa that was nearest to them, and set up there a flourishing colony—a community that excelled not only in agriculture, but in art, in poetry, and above all in philosophy. We have all heard of the Cyrenaic philosophers. It is amusing to remember that the traveller Coryat, when he wanted to write from India to his friends at home, addressed his letters to "The Most Worshipful Fraternity of Cyrenaical Gentlemen, who meet at the Mermaid Tavern in Fleet Street on the first Friday of every month." Two of these gentlemen to whom Coryat sent special greeting were Ben Jonson and Inigo Jones. So this remote African province is intimately connected with English literature!

I believe the city of Cyrene was badly damaged in the time of Hadrian owing to a revolt of its Jewish inhabitants. That may possibly have been a circumstance that led to Mr. Zangwill thinking of it as a suitable site for a colony of his compatriots. I cannot but think that the promoters were well advised to abandon their project. I cannot imagine the Jew from Central Europe having a happy time among the Senussi. I think his state might have been almost worse than if he had settled, as at one time proposed, among the lions in East Africa. What the future of Cyrenaica is likely to be seems a difficult problem. I do not myself see where the elements of any great prosperity for it are. The Italians, it is true, have done very well in Tunis, where, I believe, there are still more Italians than French. The Southern Italian peasant makes a good colonist, but will he not prefer South America? Tripoli has been described as "Egypt without the Nile," and Cyrenaica is part of Tripoli. Looking at the description of its coast, to the lack of good harbours, and to the absence of any route that would be able to hold rivalry with other trade-routes into the interior of Africa, I cannot see hopes for a long time to come for the revival of the district. One hope however I would express. The difficulties that lay in the way of archæological exploration under Turkish rule have been removed, and it is ardently to be desired that under a civilized European Government no artificial difficulties or obstructions will arise which may prevent any explorers who have the energy and money, whether they are Italian, French, American, or English, from co-operating in the excavation of sites on which there must be a great deal more to be found. I am sorry we have not been able to have a more full discussion to-night. All I can do now is to offer the best thanks of the meeting to Prof. Gregory for his very interesting lecture, and to invite him to say anything he would like in reply to the remarks of Mr. Hogarth.

Prof. GREGORY: I should like to thank Mr. Hogarth for his kind remarks. I am glad to find he agrees with me in the general conclusion regarding the unsuitability of the country for the purpose for which I specially considered it, and I suppose he and the President and myself are very much at one in our expectations as to its value to the Italians. Of course if they care to spend many millions on water-supply and other development work they can greatly improve the country. In regard to the water-supply, we saw the country at its driest time, and in order to estimate the permanent water-supply it was necessary to see the country in the summer. If we had been there during the rains we could have formed no idea of the water-supply that would be available to maintain the population through the long spells of drought. No doubt Cyrenaica presents a very different aspect after rain, and many of the glowing descriptions have been given by men who travelled there in the winter at the end of a wet season. Though the Arabs were certainly not pleased to see us they placed no serious obstacles in our way. We saw everything we wanted to see. The Turkish officials were anxious to show us the country at its best; they took us to the best places, and the only objections raised were when we insisted on seeing famous wells which were then dry, and on inspecting the more arid section of the country. In regard to the ancient population of Cyrene, I estimated it on a good many different lines, and they gave results varying from 15,000 to 25,000. I did not contrast the city with modern requirements—for instance, in questions of water-supply. I suppose ordinary cities have a water-supply allowance of from twenty gallons a day up to places like Glasgow where they use about eighty gallons a day. I allowed ten gallons a day per inhabitant, and from that would have to be deducted the water that would be used for cattle and stock and irrigation; so that the amount which would be left for personal use would be only two or three gallons. In regard to density of population, I based many estimates on analogous Eastern cities. I also compared the population and the size of its public buildings with those of some of the ancient Italian cities, and the results agreed with the estimates of some classical friends, based on the general classical importance of Cyrene. I doubt if the total population of Cyrenaica in Roman times can have been much more than half a million.

THE ASTROLABE AND WIRELESS.

Major A. J. Woodroffe, R.E.

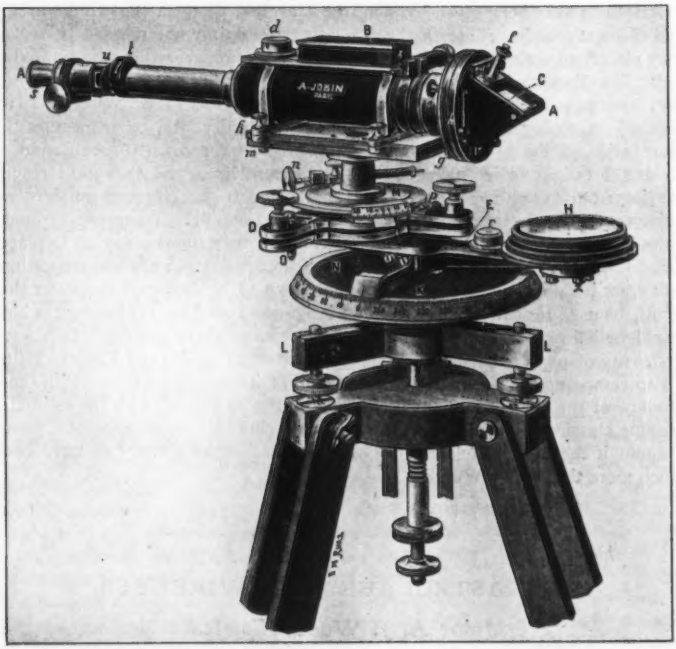
I. THE ASTROLABE À PRISME.

THE *astrolabe à prisme*, an instrument designed by MM. Claude and Driencourt for the determination of time and latitude by the method of equal altitudes, has for some reason or other not received on this side of the Channel the attention that its undoubted merits deserve. It is difficult to understand why this should be so, as it has all the qualities that an instrument for observing should possess—lightness, an extreme simplicity both of adjustment and observation, and lastly a precision that, for its weight, is truly remarkable.

The models for field use are made in two sizes, the "small" and

"geodetic." The former weighs about 35 lbs., giving a precision in time of about 0·05 sec. and latitude 1″, while the latter, weighing about 70 lbs., will give the time to 0·03 sec. and latitude to 0·3″. These figures are of course approximate, but should be obtained by a good observer after a a little practice, in the neighbourhood of the Equator. The instrument is best suited to low latitudes, and would fail entirely at the Poles, as will presently be seen.

The prices for the two models are about £50 and £100 respectively, but when it is considered that the accuracy of the geodetic model is about



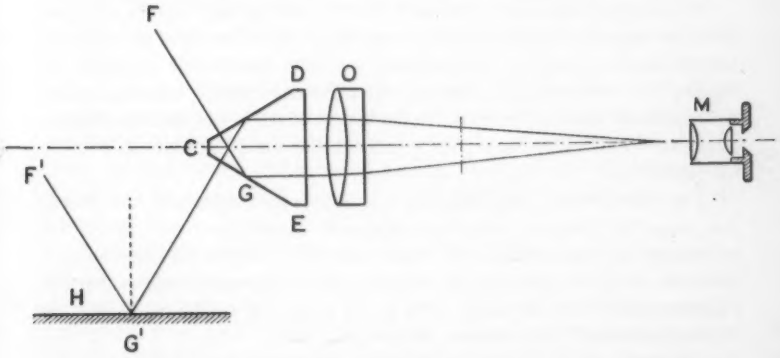
the same as that of fixed observatory instruments, at the weight of a 6-inch theodolite, the price cannot be considered excessive. The writer, after two years' experience in Peru and Brazil with the geodetic model, may certainly claim to be an enthusiast, and would never think of returning to a theodolite if he had the opportunity of using an astrolabe. Owing to its precision it is an ideal instrument for determining differences of longitude by wireless signals, a short account of which will be presently described.

The astrolabe is essentially a telescope revolving in a horizontal plane, with a 60° prism mounted on the object glass end, with one face normal to the optical axis. Suitably mounted below the prism, and revolving with

the telescope, is a specially constructed mercury bath. The latter is provided with a cover, with baffle-plates inside, to protect it from the wind.

The bath is of copper, and, except in the centre, is extremely shallow, so that when the telescope is revolved the mercury will come to rest in a few seconds. The surface of the mercury is cleaned from time to time by a glass rod, which when passed with a twirling motion along the edge of the bath removes all impurities and any excess of mercury which otherwise might tend to form a convex surface.

The instrument has three slow-motion screws, one in azimuth *n* (the mercury bath not moving), another D, which revolves the prism about the longitudinal axis of the telescope (to obtain horizontality of the prism edges), and a third *p*, by means of which the object end of the telescope may be raised or lowered to make the optical axis horizontal. A touch here and there of these three screws is necessary during observing, and



this is practically the only difficulty to an observer unused to the instrument. Facility is rapidly acquired. The instrument is of such a height that the observations are made sitting. This gives great comfort and steadiness to the eye.

It should be noted, as regards the field of the instrument, that instead of cross wires, as in a theodolite, there are two vertical and two horizontal wires forming a square in the centre. These wires can be illuminated at will by an electric bulb, the wires showing up bright against a dark background. The amount of illumination can also be simply controlled.

By means of a simple optical arrangement the prism can at once be adjusted with one face normal to the optical axis of the telescope. If a light is held near the prism, when a certain eyepiece is fitted, two images of the square are seen in the field. By means of adjusting screws the images are brought into coincidence. This can be done in a few moments. The prism is now in adjustment, and it is assumed that the instrument is levelled in the ordinary way, and is ready for observing.

It will be obvious that if the instrument is correctly pointed in the azimuth of a star which is very nearly at the altitude of 60°, two images will be seen in the field, one (FGM) direct and the other (F′G′M) reflected from the mercury, the rays passing through the exterior faces of the prism at right angles, and being reflected from the opposite faces of the prism up the telescope.

These two images are immediately brought into the same vertical plane by screw D, and then set equidistant from the horizontal wires by screw p. The images will approach, coincide, and, separating, pass away out of the field. During this time the two images will also be moving in azimuth, but still remaining in the same vertical plane relatively to each other. A touch of the azimuth screw n may be necessary to ensure that the coincidence shall take place in the square. Stars near the prime vertical will, of course, have very little motion in azimuth, while those near the meridian will move rapidly in azimuth while having a very slow motion in altitude.

It is scarcely necessary to remark that the screws must not be touched for a few seconds before the coincidence takes place, so that the mercury may be perfectly still at this moment. A little practice is necessary in judging the movement in azimuth so that the coincidence may take place in the central square. Such is the perfection of the prism that the makers guarantee that under these circumstances the error in altitude will be inferior to 0·1″.

The instrument is provided with a trough compass, by means of which, the magnetic variation being approximately known, the telescope can be set roughly in the meridian. A large time star is chosen for orientating it correctly, as if the instrument is adjusted for the known azimuth so that the coincidence for this star takes place in the square, it will be orientated for all the remainder, and need not be touched again.

It must be observed that a programme of times and azimuths has to be previously prepared. This is very simply and rapidly done by an ingenious graphical method, the azimuths and hour angles being read off at sight from a diagram which can be arranged for any latitude. The preparation of this programme takes little if any longer than the ordinary programme, and the observer is amply repaid by the delightful simplicity of the subsequent observations, as a complete set of observations can generally be obtained in one hour.

The actual data required for the observations are as follows:—

(1) The time by chronometer of the coincidence.

(2) The instrument reading of the azimuth, read off at sight to the nearest tenth of a degree.

(3) The observer's opinion of the observation, very good, good, indifferent, etc.

This is important in order that due weight may be subsequently given to that observation.

It will be noticed that, with the exception of the azimuth at sight, no

readings of any kind are necessary. The observer should have an assistant who books for him, reads out azimuth setting and time of the next star, etc. The temperature should be taken every ten minutes, so that allowance for difference of refraction can be made afterwards, if necessary. Care has to be taken that the right star is observed. There is generally no difficulty about this, as the magnitude of the star will prevent mistakes. If the wrong star is observed, however, it will show at once in the subsequent calculations.

In practice the images are arranged so that they will not actually come into coincidence, but will just not touch each other. The moment noted is when they are at the same altitude. This moment, especially in the case of circum-meridian stars, is much more definite than a coincidence.

Two great practical advantages of the instrument should here be noted :—

(1) There are absolutely no instrumental corrections to be made afterwards to the observations.

(2) The power of the eyepiece is extremely high, without a corresponding loss of light or reduction of field.

(1) Since with this instrument the mercury takes the place of the level, conditions are correct *at the moment of the observation*. In this respect it should be observed that, with the exception of adjusting the face of the prism normal to the optical axis, the remainder of the adjustments are merely for convenience of the observations, and have no influence on their accuracy.

With any instrument depending on a level there is no guarantee that the level, when read, is the same as at the moment of observation. Indeed, if the observer has to walk round to read it, it will probably be sensibly different. It may also be noted that the images cannot come into coincidence unless the edges of the prism are horizontal. Thus a theoretically perfect observation is secured.

(2) Since each of the images has a movement in altitude, their relative velocity will be double that of a star with regard to a wire, such as that of a theodolite.

In the geodetic model an eyepiece of power 75 is used, giving a relative velocity equal to that with eyepiece of 150 in a theodolite. The result is highly satisfactory, as a very clearly defined "moment of coincidence" is obtainable, even with stars close to the meridian. This is largely due to the perfection of the prism, as such a high power would not be practicable with a less perfect prism, owing to distortion of the images.

About two minutes between successive observations is the minimum convenient interval. In practice from fifteen to twenty observations well distributed round the horizon can usually be obtained in an hour, using stars given in the American Nautical Almanac. This Ephemeris is specially mentioned as it contains far more stars than our Nautical Almanac or the "Connaissance des Temps."

A difficulty may occasionally arise in getting suitable circum-meridian stars. The time of observation must in this case be arranged earlier or later in order to include them, or else recourse must be had to a catalogue such as that of M. Bossert (specially arranged for the astrolabe). In this case, however, the positions are not so well known, and for the calculations the positions have to be reduced to date, which is somewhat tedious.

Methods of Timing.

There are various methods of timing the coincidence.

(1) Electric methods.

(2) Stopwatch methods.

(3) Eye and ear, comparing distances of the images at one second and the next.

(4) Eye and ear, treating the coincidence as though it were a sound, and judging by the rhythm produced.

(5) Calling "top" to the booker.

(1) May be dismissed as being an observatory method impracticable in the field.

(2) An ordinary stopwatch registering $\frac{1}{5}$ths is hardly accurate enough, as this under the most favourable circumstances may have an error of 0·2 sec.

Messrs. Dent & Co., however, make a special "time of flight" stopwatch, guaranteed accurate for a minute, which registers $\frac{1}{100}$ths of a second. Most excellent results have been obtained with this, notably by untrained observers. The watch is started on the coincidence and stopped on a beat of the chronometer, the time of which is noted. The latter, less the stopwatch interval, gives the chronometer time of the coincidence. It has the great advantage of leaving the observer's mind free to concentrate on the coincidence, and it ought not to be possible to make a mistake of half a second on a definite beat of the chronometer, an important point.

In the case of (3) and (4), the observer has to take up a beat and keep counting, while he manipulates the screws. This requires some practice, and unless great care is taken there is always the risk, if hurried and the light is bad, of taking up the wrong beat. This difficulty, however, can be got over, if a telephone is available, by placing one receiver near the chronometer where the beats can be heard (in which case the chronometer is with the booker), the observer having the other receiver attached to his ear. At a signal from the observer the booker taps three consecutive seconds on the telephone with his pencil, and books the time of the first tap. The observer starts counting on the first tap 0, 1, 2, and continues to do so, listening to the beats on the telephone. When the coincidence takes place he calls out the seconds and the fraction, which have to be added to the time booked by the assistant.

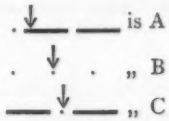
In this case the observer will have suitably arranged his images before calling to the booker to begin.

In the case of (3), he counts seconds, and mentally compares the vertical distances between the stars the second before and the second after the coincidence, estimating the fraction of the second in tenths by the corresponding distances, regarding the sum of the two distances as the total travelled by the images in the course of a second.

In the opinion of the writer method (4) is the most accurate of all, though it requires some practice at first. In this the observer counts the half seconds, 1 *and*, 2 *and*, 3 *and*, etc., and refers the coincidence to its position in the half second as if it were a sound making a certain rhythm with the beats.

Thus the coincidence may take place on a beat, directly after (A), midway between (B), and just before a beat (C). Thus if the coincidence on a beat is eliminated, the observer has only to decide whether it is (A), (B) or (C). The rhythm corresponding to any of these three positions is very marked, and although nominally the time is only being registered to $\frac{1}{8}$th second, yet if the observer does not mistake one for the other he is unlikely to commit an error greater than $\frac{1}{10}$th of a second.

A buzzer signalling in Morse the letters W, S, K, give an idea of the rhythm, the letter S being signalled rather slowly.



The arrow represents the coincidence.

The observer calls out the seconds and letter, which are so booked and afterwards reduced.

For instance 12 *and* C = 12·5 + 0·375 or 12·875 secs.

9 B = 9·25 secs.

This system can also be applied to a watch or chronometer beating $\frac{4}{10}$ths, which nominally provides more accuracy, but it is so easy to pick up the beat wrong that half seconds appear preferable.

System (5) may be dismissed at once as hopelessly inaccurate, involving as it does the error of the observer in calling, and that of the booker in estimating the fraction.

This matter of the timing has been gone into at some length, but with the astrolabe it is the one all-important point. Indeed, the instrument is so perfect that it seems to call for something refined in the way of timing.

Computations.

The method is an adaptation of that of Gauss.

The rate of the chronometer is assumed to be known. The latitude and error of the chronometer at any convenient epoch (say the first observation) being approximately known, quantities are assumed for these and the corresponding zenith distances computed. The necessary

corrections are then found by the method of least squares to satisfy the condition that all the zenith distances shall be equal.

In Gauss's method the equations were set forth, and the corrections found mathematically. If this were done after a night's observation with the astrolabe the unfortunate observer would spend the next fortnight in producing the result.

But in this, as in the preparation of the programme, MM. Claude and Driencourt have found a delightfully simple and accurate graphic solution.

The zenith distances are *calculated* as above to the nearest tenth of a second of arc. The chronometer times of observation must be corrected for its rate, so that all the observations are referred to the same epoch, which would have the same effect as observing with a rateless chronometer. The rate can be found either by comparison with another chronometer which has not been disturbed, or from the observations themselves, or if observations have been taken in the same spot the night before, by comparing the times at which the same stars coincide on the respective nights.

Two lines drawn at right angles represent the meridian and prime vertical respectively at the zenith.

Their intersection at O represents the assumed zenith.

Assume any convenient zenith distance ζ smaller than the smallest calculated one.

Deduct this from all the zenith distances, ζ_1, ζ_2, ζ_3, etc.

Assume any convenient scale, say 2 mm. = 1″.

Draw dotted lines from O for each star along its observed azimuth, and set up perpendiculars at the distances $\zeta_1 - \zeta$, $\zeta_2 - \zeta$, $\zeta_3 - \zeta$, etc.

Then the centre O_1 of the circle which tangents the majority of the perpendiculars is the required zenith.

The correction to the assumed latitude is O_1X, and to the assumed error of chron. is OX. In arc and time, where ϕ is the latitude :—

Correction to the assumed latitude in arc = O_1X according to the scale.

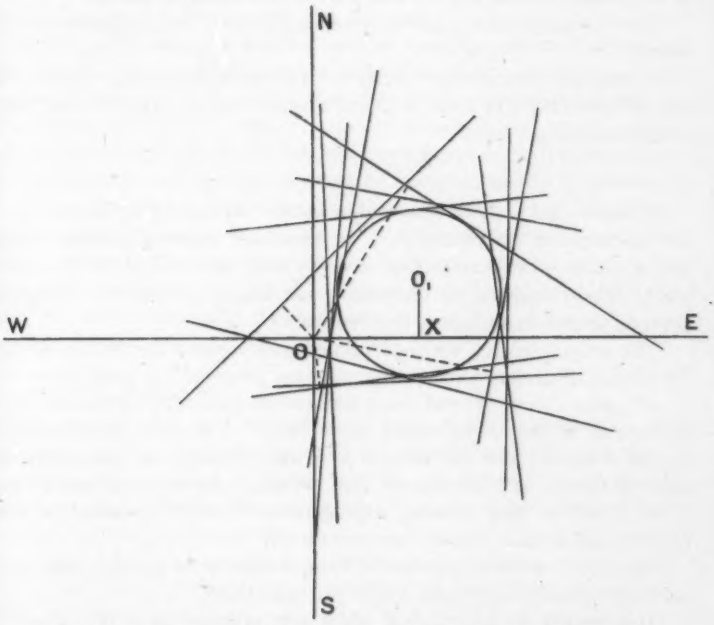
Correction in time to the assumed chronometer error at the epoch selected = $\frac{OX}{15 \cos \phi}$ secs. ; the chronometer being slower or less fast if O_1 is to the east.

The true zenith distance is the assumed zenith distance plus the radius of the circle.

If the observations were perfect all the perpendiculars would touch the circle ; but even when this is not so, as in practice, there is very little difficulty in finding the centre of the approximate circle, taking into account the quality or weight of the observations from which the lines are drawn. It is, in other words, a graphic solution by least squares, by means of which a circle is found which best satisfies the condition that all the zenith distances shall be equal.

Theoretically, if the distances of the tangents from the circle are d, d_1, d_2, etc., with weights of observation w, w_1, w_2, etc., that circle is correct for which $(dw)^2 + (d_1w_1)^2 + (d_2w_2)^2 + \ldots$ is a minimum.

It will be at once seen from the diagram that the circle is best defined by observations all round the horizon, the circle itself showing immediately the quality of the observations, and rejecting any observation which is taken to a wrong star, or in respect of which the minute has been booked wrong, or similar mistakes made. To obtain good results there should be a pair of north and a pair of south circum-meridians and half a dozen time stars on each side, sixteen in all.



Note.—Some azimuth lines have been omitted for the sake of clearness.

It will be observed that to avoid errors from convergence of meridians on the flat paper, and to keep the diagram conveniently small, the assumed latitude and chronometer error must not be far out from the true value, say within 15″ and 1 sec. respectively.

These quantities can be found in a few minutes within this error by computing three stars widely differing in azimuth and plotting them on a much smaller scale, say 1 mm. = 10″. As a test the zenith distance found from the diagram should agree with the known zenith distance of the instrument. With these new values the entire series is computed.

Correction for Refraction.

A table can be made out once for all showing the corrections for variation of refraction (due to changes of temperature) for every degree, and these can be added or deducted at sight to the computed zenith distances. For an altitude of 60°, however, the variation in these corrections is very small, and in many cases is quite negligible.

A most ingenious table has been compiled by a French officer which greatly reduces the labour of computation, the common zenith distance in this case being taken as 30° 0′ 33″·3, and the tables giving at once the excess or defect on this quantity. The argument used for the tables is $\phi - \delta$, where ϕ is the latitude and δ is the declination of the star.

Three logarithms only are required, and of these one is common to the series.

A special transparent protractor is made for facilitating the drawing of the perpendiculars, or lines of altitude, which ensures accurate and easy draughtsmanship.

Preparation of Tables.

If much work is to be done within known parallels of latitude, a table can be prepared beforehand from an almanack, showing sidereal times and azimuths when stars arrive at 60°. This table will serve for some years without appreciable correction, and though laborious to prepare, saves an enormous amount of time eventually.

The writer prepared and had printed such a table for the use of the Peru-Brazil Boundary Commission. It was prepared for south latitudes 9°, 10° and 11°, and showed every star in the American Ephemeris that attained an altitude of 60° within those limits. The data given for each degree of latitude were the sidereal time and azimuth, and corrections to these two latter for differences of 1° of latitude. As the stars were shown in the order of their crossing, a programme could be prepared in any intermediate latitude in a few minutes for any hour.

This involved the calculation of some thousands of passages and took about five months to prepare, working in spare time.

It is the writer's belief that if tables were prepared every few years for all latitudes between 60° N. and 60° S. by some patriotic body, the use of this instrument would become almost universal.

II. Determination of Longitude by Reception of Wireless Signals.

If the longitude of a powerful wireless station is known, and the observer is provided with the simple outfit necessary to receive signals, a very accurate determination of the longitude of his position can be effected by the reception alone of wireless signals, if the following conditions can be carried out.

At the power station is installed a pendulum beating say $(1 - \frac{1}{50})$

sidereal second. This pendulum actuates a relay which can be put into the main sending circuit, so that at every beat of the pendulum a wireless signal is sent out.

The length of signals is adjustable from $\frac{1}{10}$ sec. to $\frac{1}{2}$ sec. It is clear that in 50 beats this pendulum will gain a beat on a chronometer keeping sidereal time, so that if the observer can receive the pendulum signals, and is using a sidereal chronometer beating half-seconds, he will get a coincidence every 25 seconds approximately. He may be regarded as using a Vernier time-scale to compare his chronometer with the pendulum.

Here, then, is a very accurate method of comparison, and it only remains to be decided how many coincidences are required, and to what signal of the pendulum they are to be referred.

At the power station is another observer *who also receives these wireless signals.* If it be conceded that the difference in time of arrival of the wireless signals to the near and distant stations is negligible, it will be seen that as any delay due to the action of the relays, etc., equally affects both observers, such delay will have no effect whatever on the accuracy of their comparisons with the pendulum at the same moment.

In practice the first beat of the series sent by the pendulum is generally chosen for this moment. Each observer determines his chronometer time of this beat. It then only requires the application of the correction for error of his chronometer on L.S.T. at that moment, to obtain the sidereal times of the two stations at the same instant, and their difference is the required difference of longitude.

Programme of Signals, etc.

Any convenient hour may be chosen for commencing the signals. Say the signals are to commence at 9 p.m. mean time of the power station.

At 8.50 p.m. a series of signals may be sent for $9\frac{1}{2}$ minutes exactly (then a rattle of the key for 20 seconds), in order to give time to tune the receiver and prepare for the signals. At 9 h. 0 m. exactly the signals commence, and are sent, say, for 240 beats = 4 minutes nearly, every 59th signal being omitted (there is a switch for doing this) as a register of the minutes.

If the 240th beat is sent, 4 will have been left out, and 236 signals will have been sent. Two minutes may be allowed to lapse, and a second set of 4 minutes sent. This will generally be sufficient, as each set will give 9 or 10 coincidences.

The observer has a microphone attachment to his chronometer, by means of which the sound from the chronometer can be regulated to suit the strength of the wireless signals. This is not necessary, but facilitates comparison. He can then hear in the same telephone the signals and his chronometer beats. The chronometer beats are damped out for his assistant, who is solely occupied in counting the signals.

The observer taps with the pencil on a coincidence, noting the

chronometer time, while his assistant notes the number of the corresponding signal. It is best for him to keep a tally, encircling the coincidences and underlining the signal following the omission. If the number of signals counted is 236, he will know that he has received them all. This is important, as the first few signals may have been missed for some reason, in which case the numbers can be afterwards checked backwards from any minute.

The following is a specimen of the booking, the outside columns being added later. In this case the omitted signals have been added for clearness. The necessary formulæ are shown :—

Chron. Intervals between coincidences.	Chron. times of coincidences. h. m. s.	Corresponding number of signal sent from power station.	Signal intervals.
	9 10 0·0 ...	... 10	
24·5		...	... 25
	10 24·5 ...	... 35	
23·5		...	... 24
	10 48·0 ...	... 59	
26·5		...	... 27
	11 14·5 ...	... 86	
23·5		...	... 24
	11 38·0 ...	... 110	
23·5		...	... 24
	12 01·5 ...	... 134	
26·5		...	... 27
	12 28·0 ...	... 161	
24·5		...	... 25
	12 52·5 ...	... 186	
24·5		...	... 25
	13 17·0 ...	... 211	
23·5		...	... 24
	13 40·5 ...	... 235	
Sum = 220·5			Sum = 225

Required the chronometer time of the first signal sent from power station.

Then 225 beats of power station = 220·5 secs. chron.

and 1 ,, ,, ,, $= \frac{220{\cdot}5}{225}$,, ,,

As a check the differences between first and last coincidences will also give these quantities.

Then the chronometer time of the first signal may be found from each of the coincidences by deducting from the chronometer time of the coincidence the number of beats less one of the signal corresponding (this interval being expressed in chronometer time).

It is assumed that the first signal is counted 1.

h. m. s.

Thus from the 1st coincidence : Chronometer time of first signal = 9 10 0 $-(10-1)\frac{220{\cdot}5}{225}$

,, ,, 2nd ,, ,, ,, ,, = 9 10 24·5 $-(35-1)\frac{220{\cdot}5}{225}$

,, ,, 3rd ,, ,, ,, ,, = 9 10 48 $-(59-1)\frac{220{\cdot}5}{225}$

and so on.

The formula can be generalized as follows :—

If the number of observed coincidences = n

,, sum of chronometer times = Σ chs.

,, ,, signals = Σ sig.

,, interval in secs. between first and last chronometer coincidence = I_c

,, ,, between signals corresponding to these = I_s

then the mean chronometer time of first signal sent

$$= \frac{\Sigma \text{ chr.}}{n} - \frac{\Sigma \text{ sig.} - n}{n} \times \frac{I_c}{I_s}$$

If two or more sets of signals are sent, $\frac{I_c}{I}$ may be more accurately found by taking the first and last coincidences in each set.

The mean value of the comparison by this method should not have an error greater than 0·02 secs., so that the great advantage of using an accurate instrument, such as the astrolabe, for the determination of the chronometer error is seen at once. A great many details have been necessarily omitted for want of space, but in general it may be said that the really important point is to have a very clear and definite programme of signals arranged, as it must not be forgotten that the distant observer can only *receive*, and this programme must be rigidly adhered to.

The signals must be sent every night, whether the power-station observer has been able to get observations or not, for the distant observer may have been able to do so, and if his station is not a very important one, he may be content to get an interpolated value of the time at the power station (where the chronometer is not moved). A system of signals must therefore be devised at the end of the set showing whether observations at the power-station have been obtained, followed by the L.S.T. of the power station for the first signal of the night before or of such a date. This will enable the mapping to be proceeded with in the field. Any news or instructions can be sent after the signals. Accurate diaries will, of course, be kept by all parties, and the results checked when they meet.

Some Notes on the Method.

A single wire of 100–300 yards long may be used as an aerial. For good results this should be above the trees in the vicinity. The trees themselves should be used for fixing the aerials to, as in forest it is impossible to erect masts from the ground. Clearings in the forest, or aerials crossing a river are suitable. The whole wireless outfit can be carried by two men.

It may be noted as an interesting point that when the Peruvian Commission were working with signals sent from the wireless station in Senna Madureira, Brazil, the signals from the wireless stations in Iquitos and San Cristobal (the latter being in Lima) could be heard so plainly that they had to be tuned out to avoid interference. As the distance was something like 300 miles to San Cristobal, with the mountainous Andes between, it may be seen how effective the system is, even in dense forest.

The observer at the power station has a very simple though important task. He can arrange for his instrument to be permanently mounted on a masonry pillar with removable roof, so that once set it remains correctly

levelled and orientated in azimuth. As regards his computations, once the latitude is determined, he is only concerned with time stars, and it is merely a question of shifting his diagram circles east or west.

It is much to be regretted that no actual examples of the work can be given, as they are not available at the moment; but it is hoped that the above notes will at any rate make clear the principles involved in this most interesting and accurate modern method, which abolishes at one stroke the cutting of traverse lines through a forest, with all its laborious measurements, calculations, and tedious delays.

EXPEDITION IN CENTRAL ASIA.*

Sir Aurel Stein, K.C.I.E., D.Sc.

Dated Dalbandin, Seistan-Nushki route, 17 February 1916.

ON 6 July 1915 I left Kashgar after having completed the careful repacking of my eighty heavy camel-loads of antiques for safe transport across the Karakoram to India. The melting snows in the Kun-lun range would not allow the valuable convoy to be started at once; so Rai Bahadur Lal Singh, who was to take care of it on the long and difficult transit, had set out in the meanwhile to complete our topographical labours in Chinese Turkestan by a careful survey of the high snowy mountains which continue the Muztagh-ata range to the headwaters of the Kashgar River.

Before he rejoined me for final instructions I was busy with many urgent tasks in the delightful seclusion of a small fir-clad alp to the south-east of the high Ulugh-art Pass. On July 19 I started across it for my long-planned journey westwards. It was first to take me across the Russian Pamirs to those mountain tracts north of the Oxus which by reason of their ethnic and historical associations and their varied geographical interest have had a special fascination for me ever since my youth. Considering how long I had wished to see this extreme east of ancient Iran I could not feel too grateful to the Imperial Russian Government which had readily granted permission for my journey across ground in parts never visited before by any British traveller.

Of the generous and kind way in which the Russian political authorities were prepared to facilitate my travels I had soon conclusive proof when after a week's rapid journey over the northernmost Chinese Pamirs, I struck the road leading to the Russian Pamirs where it crosses the Trans-Alai range. Here I had the good fortune to meet Colonel I. D. Yagello, holding military and political charge of the Pamir Division, which now includes also Wakhan and Shughnan. I could not have hoped even on

* See *Geographical Journal*, vol. 46, p. 269.

our side of the Hindu Kush for arrangements more complete and effective than those which this distinguished officer had made on my behalf. It was an additional pleasure to find in him an Orientalist scholar greatly interested in these regions and anxious to aid whatever investigations could throw light on their past. I owe it mainly to Colonel Yagello's unfailing aid that I was able to cover so much interesting ground, far more than my original programme had included, within the available time and without a single day's loss.

To study questions of historical geography on the spot was one of the chief objects for which I had planned this journey. So it was a special satisfaction for me to be able to march down the whole of the big Alai valley and to trace additional indications supporting the belief that through it passed the route which the ancient silk traders, like the agents of "Maës the Macedonian," followed from Bactra to "the country of the Seres" or China, as described in a much-discussed record of Marinus of Tyre. Various considerations make it appear to me very probable that the latter's "Stone Tower" must be placed about Daraut-Kurghan, where the route up Kara-tegin, the only direct one between ancient Bactria and Eastern Turkestan practicable throughout for laden camels, emerges upon the Alai.

From there I turned south to strike across the succession of high snowy ranges which separate the headwaters of the Muk-su and the Roshan and Shughnan rivers from the uppermost Oxus. It was a difficult route to follow even with such exceptionally hardy transport animals as Colonel Yagello's orders secured for me from the rare Kirghiz camps encountered. But there was abundant reward in the mass of interesting geographical observations to be gathered. As far as the Tanimaz River our route led past the magnificent glacier-clad range, vaguely known as Sel-tagh and still awaiting accurate survey, which forms the north-western buttress of the Pamirs. Thence I reached the first Iranian-speaking settlement of hill Tajiks or Ghalchas high up on the Bartang or Roshan River.

Our progress up the narrow gorges of the Bartang proved exceptionally trying owing to the results of the great earthquake of 1910. The huge landslips attending it had destroyed what tracks there existed in the valley. It took three days' hard scrambling along spurs almost impassable for load-carrying men and over vast slopes of rock debris to reach the point where the fall of a whole mountain has completely blocked the river and converted the so-called Sarez Pamir into a fine alpine lake over fifteen miles long and still spreading up the valley. It meant another day's stiff and in places risky work before we succeeded in crossing the few miles of precipitous rock slopes above the Yerkht inlet, whence a pass leading to the Yeshil-kol lake could be gained.

Here I found myself on ground of varied geographical interest. On the one hand, with the experience gained at the newly formed big lake fresh before me, it was easy to recognize those topographical features

which clearly point to the Yeshil-kol having derived its existence from a similar cataclysm at some earlier period. On the other hand what I saw on my way up the Alichur Pamir, and subsequently in the main Shughnan valley below it, clearly showed the advantages which this route ever since Kao Hsien-chi's memorable Pamir campaign of 749 A.D. had offered for Chinese expansion to the Upper Oxus and Badakhshan.

After crossing the Bash-gumbaz, our fourth pass over 15,000 feet since the Alai, I descended to the glittering expanse of Lake Victoria and reached the Great Pamir branch of the Oxus. It was a delightful sensation to find myself on ground closely associated with the memories of those great travellers, Hsuan-Tsang, the famous Chinese pilgrim, Marco Polo, and Wood.

My subsequent journey down the Oxus was attended by an abundant harvest of observations on the historical topography, archæology, and ethnography of Wakhan which in early times had formed an important thoroughfare between Bactria, India and the Central Asian territories of China. The exact survey of a series of ruined strongholds, some of considerable extent, brought to light numerous features of archæological interest. That these hill fastnesses date back to pre-Muhammadan times and to an epoch when this portion of the Oxus valley contained a far denser population than at present, is certain. Some architectural details suggested a period corresponding to late Indo-Scythian or early Sassanian domination.

In spite of the high elevation, from 8000 to over 10,000 feet above sea-level, the cultivated portion of Wakhan still presented a verdant appearance, doubly welcome after the bleak Pamirs. The effect was heightened by splendid views of the grand Hindu Kush chain to the south. So I was glad that plentiful antiquarian, anthropometric, and philological work kept me busy in Wakhan during the first half of September. Then, passing down the Oxus below its great northward bend, I visited Colonel Yagello's headquarters at Kharuk and passed into the Shughnan valleys. They figure often in Chinese and early Muhammadan records of the Middle Oxus region, and their secluded character has helped to preserve a great deal of old-world inheritance in ethnic types, local customs, domestic architecture, etc.

From the Ghund Valley I crossed into Roshan by the difficult glacier pass of Shitam, over 16,000 feet high. From the ice-crowned watershed there opened a glorious vista over the rolling uplands of Badakhshan, a region towards which my eyes have been turned for many years—and which still remains inaccessible. The narrow gloomy gorges of the Roshan River proved even more troublesome than the pass by which we had reached them, and after two days' scramble past precipices by steep rock ledges and rough galleries it was a relief to emerge once more in the less-confined valley of the Oxus. Roshan, just as it is the least accessible of all the side valleys of the Oxus, seems also to have preserved the *homo*

alpinus type of the Ghalchas in its greatest purity. I was greatly struck by the remarkably fair looks of the whole population.

By crossing the glacier pass of Adude I made next my way into the Yazghulam and Vanj valleys of Darwaz, where the territory of the Amir of Bokhara was entered. Here too the recommendation of the Russian political authorities had assured me all possible help and attention. The gradual change in the physical appearance, ways of living, etc., of the people as we passed further and further north bore testimony to the historically attested conquest of Turk tribes. The Sitargh Pass, with its badly crevassed glacier, was crossed just in time before the first heavy snowfall closed it, and finally we gained by the Gardan-i-Raftar Pass the main valley of Kara-tegin.

In Kara-tegin I found myself once more on the line of the ancient silk trade route to Bactria. It was interesting to note here how the old Kirghiz invaders are being slowly ousted again from the land by a steady reflux of Tajik settlers. A succession of rapid marches then carried me through the open and remarkably fertile valleys drained by the rivers of Kafirnihan and Surkhan to the confines of ancient Sogdiana about Shahr-i-sabz. Finally, on October 22 I reached Samarkand and the railway. My journey since leaving the Kashgar Mountains had lasted just over three months, and within these we had covered on horseback and on foot a total distance of 1700 miles.

After a few days spent at Samarkand and Bokhara, where the great monument of the Mogul period claimed visits, I travelled by the Trans-Caspian railway to Askhabad *en route* for a new field of work on Persian soil. By November 4 I reached Meshed, where Colonel T. W. Haig, C.M.G., H.B.M.'s Consul-General for Khorasan, offered me the kindest welcome and the chance of a much-needed short rest. There I learned by wire the gratifying news that my 183 cases with antiques had safely arrived in Kashmir.

Seistan was my goal for the winter's work, and in order to reach it I chose a route which, leading off the main roads, gave opportunities for useful supplementary survey work, while it is also the most direct. Starting from Meshed on November 11 we travelled by little-frequented hill-tracks to Rui-khaf, and thence south in an almost straight line parallel to the Perso-Afghan border, until we struck the high-road at Bandan, two marches from the Seistan "capital." The total distance of over 500 miles was covered in twenty-one days, and with the assistance of my energetic young surveyor, Afrazgul Khan, a careful plane-table survey on the scale of 4 miles to the inch was carried over the whole ground. The disturbed conditions of Persia due to the war made themselves felt to some extent also on the Khorasan side. But my journey passed off without awkward encounters.

Since my student days I had been drawn to Seistan by the hope of finding among its numerous ruined sites remains of the periods when

ancient *Sakastana* served as an outpost of Iran and the Hellenistic Near East towards Buddhist India. My explorations in the Tarim basin provided a strong additional reason, for the striking analogy presented by various physical features of the terminal basin of the Helmand River was likely to throw light on more than one geographical question connected with the dried-up delta round Lop-nor. In both directions my hopes have been fully justified by the results of my Seistan work. Various circumstances imposed upon it the character of a reconnaissance. Yet even thus it could not have been carried through successfully within the available time had not Major F. B. Prideaux, C.I.E., H.B.M.'s Consul in Seistan and Kaian, given me the kindest and most effective help and the benefit of his wide local experience. I derived most useful aid, too, from the excellent topographical surveys which had been effected under the direction of Mr. G. P. Tate, of the Survey of India, in connection with Sir Henry McMahon's Seistan Mission of 1902–05.

My archæological search was rewarded at the very start by an important discovery. The extensive ruins situated on the slopes of the Koh-i-Khwaja hill, which rises as a conspicuous landmark above the Hamuns or terminal marshes of the Helmand, proved to be the remains of a large Buddhist sanctuary, the first ever traced on Iranian soil. Their location at a site which to this day has retained special sanctity for the Muhammadans of Seistan once again strikingly illustrates the continuity of local worship. Hidden behind later masonry, there came to light remarkable fresco remains which undoubtedly date back to Sassanian times. Further search in a gallery below the main temple revealed wall paintings of a distinctly Hellenic type. These pictorial relics illustrate for the first time *in situ* the Iranian link of the chain which connects the Græco-Buddhist art of the extreme north-west of India with the Buddhist art of Central Asia and the Far East. The architectural features of the ruins were also of great interest, reflecting that connection with equal clearness.

Remains of much earlier times were disclosed by my survey of the desert to the south. There, in an area once watered by an abandoned old branch of the Helmand, excessive wind-erosion acting on alluvial clay had produced conditions exactly resembling those with which I had become so familiar in the dried-up delta north of Lop-nor. The scouring by wind-driven sand had here lowered the original ground level to varying depths, down to 20 feet or more, except where the surface had been protected by hard debris of some kind. The erosion terraces thus left rising island-like above the bare plain were always found thickly covered with prehistoric remains, consisting of potsherds, often decorated, and stone implements mainly of the Neolithic period, but in places including also relics of the Bronze Age. Here a rich and interesting archæological harvest could be picked up literally on the surface.

In a portion of this desert area Muhammadan ruins attested a temporary return of the fertilizing river water during a relatively recent period.

But of far greater interest was the unexpected discovery of a close line of ancient watch stations stretching right across the desert from the southernmost Hamun in the direction of the salt basin of the Gaud-i-Zirreh. The experience gained during my explorations along the ancient Chinese wall discovered in 1907 in the desert of Tun-huang helped me greatly in tracing this Seistan *Limes*. The fortified frontier posts, solidly built after a uniform pattern, were found always to occupy erosion terraces, chosen no doubt for the sake of increased command of ground, at distances from half to about one and a half miles apart. The position of sectional headquarters could also be identified.

A variety of archæological finds and observations points to the early centuries of our era as the time when this ancient border-line was established. It was intended to safeguard the cultivated portion of the Helmand delta from raids of nomadic tribes from the south. The analogy presented to the ancient Chinese frontier line of Kan-su constructed *circ.* 100 B.C. against Hun raids from Turkestan is certainly very curious. Would one be justified to regard this fortified Seistan border as a link between that old "Chinese wall" in the desert and the *Limes* lines by which Imperial Rome protected its marshes in the Near East and elsewhere? Only future researches could give a safe answer.

By the new year (1916) I returned to the inhabited portion of Persian Seistan, and was kept busy during the next few weeks with the examination of the numerous ruins surviving there. The physical conditions of the present Helmand delta account for the fact that almost all proved of mediæval Muhammadan origin or even more recent. At two sites, however, well above the level of irrigation or periodic inundation, I discovered definite archæological evidence of ancient occupations, including pottery inscribed in early Aramaic characters.

Permission to visit the Afghan portion of Seistan, where Sir Henry McMahon's Mission had found a large number of ruins awaiting expert examination, could not be secured. So after using a final stay under Major Prideaux's hospitable roof for the collection of anthropometric materials, I returned to the desert south, and completed my survey of the ancient *Limes* by some excavations which disclosed interesting details as to the internal arrangements of those ruined watch-stations and the life once led there.

At the beginning of February I set out for the return journey to India by the Seistan-Nushki trade route which the zeal of Captain (now Colonel) F. Webb Ware, C.I.E., of the Indian Political Department, had first pioneered through the desert some twenty years ago. To me this desert journey of over 400 miles has its special interest; for it illustrates to perfection the conditions once prevailing on that ancient route through the Lop desert which was opened about 110 B.C. for the expansion of Chinese trade and political influence westwards, and which two years ago I succeeded in tracking through waterless wastes after sixteen centuries of

abandonment. In geographical and historical aspects it furnishes a most instructive analogy, even though the physical difficulties encountered on that ancient Lou-lan route must have been far greater than those successfully overcome on this its modern counterpart.

In a few days I hope to reach Nushki, whence the railway is to take me for brief visits to Delhi, Dehra Dun, and Lahore in connection with future labours on the results of my expedition now completed. It has lasted two years and seven months, as I started from my Kashmir base in July 1913.

NOTES ON THE ALTO RIO BRANCO, NORTH AMAZONAS.

R. H. Blake.

THE main Rio Branco discharges through its several mouths into the Rio Negro in the neighbourhood of Carvoeira and Moura, the geographical co-ordinates of the former place being lat. 1° 24′ S. and long. 18° 49′ west of the meridian of Rio de Janeiro, which is 43° 10′ 21″ west of Greenwich. On ascending the river one threads through such a maze of islands and islets that it is extremely difficult to know which is or is not the mainland; but once clear of the obstructed area it is seen that the river has a width of roughly 2 kilometres and an approximate current during the rainy season of 4 knots per hour. As its name denotes, it is a white-water river, and carries with it much earthy sediment, especially when the flood level is falling and the waters which have spread themselves over the igapô (forest bordering the river which is flooded during high water) and campos (savannahs) are receding into the main river, taking with them a considerable quantity of soil and humus.

Where the Rio Branco discharges into the dark waters of the Rio Negro it is possible to trace its course for some distance, as is the case lower down, where the division of the waters of the Negro and Solimões is easily noted. Very few houses are met with, and these are invariably the abode of seringueiros (rubber tappers), and are of the ordinary wattle and daub construction, with roofs formed of the leaves of the burity (*Mauritia vinifera*) and palmito (*Euterpe edulis*) palms, which abound. The former is known as "mirity" locally. The surrounding country is entirely composed of forest of a typically Amazonian nature—a tangle of dense undergrowth and stout creepers under fair-sized trees—and in many places, during the rains, the igapô extends back many miles from the river, and has during the dry season the broken lumpy surface known as "torrão." Rubber trees (*Hevea brasiliensis*) and the Brazil nut tree (*Bertholletia excelsa*) abound, and of the numerous hardwoods the most sought for ordinary purposes are the pao rainha for general construction and the itauba

(*Oreodaphne Hookeriana*) for the making of canoes and batalões (barges). Some other woods are massaranduba, iacarandá, pirandahi, and frejô.

As a general rule one may say that the Rio Branco is easily navigable for the usual river-trading craft from May to September as far north as Caracarahi (about 244 miles), which marks the tail of the Cachoeiras (rapids), and for boats drawing not more than 5 feet the reach above the broken water is attainable by means of the natural canal known as the "Furo de Cujubim," which passes around the rapids; but this is only possible when sufficient rain has recently fallen, as the river raises and lowers its level very rapidly during the rainy season.

The cachoeiras extend over a stretch of about 16 miles, the only fall of any note being the Pancada Grande at Bem Querer. This may have a vertical drop of 4½ feet. Other bad spots are known, as—from south to north—Lage da Onça, Rabo da Caxoeira, Bota-Panella, Germano, Rebogo, Pancada Grande, already mentioned, Cotovello, Guariuba, and Sucurijú. The reach extending from the head of the rapids to Forte São Joaquim, which existed at the bifurcation of the Rio Branco, has about 106 miles, and is also navigable during the rains, as are, for limited distances, the Uraricoera, Parimé, Tacutú, and Surume. During the dry season, however, even the main river is only navigable for very small launches—and that with difficulty. The forest country ends abruptly in lat. 2° 30′ N., and the boundaries between it and the campos are, on the west of the river, the Rio Mucujahy, and on the east the Quitauahú, both tributaries of the main stream.

The only collection of houses dignified by the name of "villa" possessed by the Rio Branco is Bôa Vista, which may contain about sixty abodes, several of which are built of brick, as is the church. The inhabitants number about three hundred, and as a tribute to their "industry" I may mention that there is only one "roça" (field) in the neighbourhood, the inhabitants depending on the Indians for their food. The "brancos" are for the most part Brazilians and half-caste Indians, although a fair proportion are Portuguese of a low type. It is principally owing to the last-named that the place, which has been established for about forty years, has never developed.

Continuing to the north of Bôa Vista, which is about 25 miles to the north of the Rio Macujahi, is campo, and except for several very small isolated patches of forest this type of country extends up to the Serra da Paracaima (on most maps spelt Pacaraima) or "Ouracaima," as it is called by the Macusi Indians, meaning "range of hills," which mountains form the Brazil-Venezuela boundary, and eastward to beyond the Rupununi River in British Guiana. The campos run to the west to an unknown point, but, from what the Indians told me, the forest must commence somewhere in the locality of the Paraná de Maracá along the Rio Uraricoera.

These campos have running through them the headwater tributaries of

the Rio Branco, which divides into the Tacutú and Uraricoera at lat. 3° 2′ N. The latter river runs practically in a westerly direction with two tributaries—the Parimé and Majary, both running to the Venezuelan border, on which they rise. The Parimé discharges into the Uraricoera at lat. 3° 29′ N. The Tacutú runs towards the north until it reaches its tributary, the Mahú (Ireng), on the British Guiana border, at lat. 3° 34′ N., long. 59° 50′ 16″ W., where it turns east and eventually south, here forming the boundary between British Guiana and Brazil. Its other feeders are the Surumú and Cotinga, which both rise on the Venezuelan border.

In these campos one can travel day after day in flat grass country, the only timber being the caimbé and mirixy, which are worthless from a lumber point of view, being nothing more than large shrubs. At times one meets what is called a "caimbezal" or copse of these trees, but as a general rule they are very scattered and do not obstruct the horizon in any way. In fact, on very many occasions I slept upon the ground, as I was unable to find a tree large enough to sling my hammock to. Wind blows persistently from the north-east, tempering the heat in very great degree. The average temperature runs about 85° to 90° Fahr.

While making a survey of the Rio Parimé I encountered an interesting painted stone in lat. 3° 56′ N. This is known by the Macusi Indians as "Tamourimá," which only means "big stone." The stone, which stands about 120 feet high, is of gneiss and rises abruptly from the level plain. It has the shape of a man's head with the face cut away flat from the brow to the chin. On this face are painted various characters in red. In front are two slabs of stone which formed a table or altar. I questioned the chiefs and medicine men of the local tribes, but could gain no information as to the origin of this work. It is within a few hundred yards of the river and is visible for some distance all around. There are also several huge stones cropping out of the plain round this painted stone. All this savannah country is known as the Fazendas Nacionaes, and cattle were placed in the lower part, I believe about two hundred years ago, but at the present time they only exist generally up to practically the locality of the painted stone, a few, either wild and unbranded or looked after by Indians, being met occasionally to the north of this district.

No Brazilians or half-caste Indians are found north of this district, and up to the Venezuelan frontier one now meets the Macusi, Uapixana, and Aricuná Indians only, for much the greater part in their naked and unashamed condition, the men wearing a cotton cord round the waist with a piece of cotton rag tucked in it in front, passed under the crutch and tucked in again behind. The women use a "moçá," which consists of a trapezoid of beadwork measuring about 10 inches by 8 inches hanging in front; often the Egyptian key pattern is worked into them.

The Macusis, from what I understood from them, do not believe in a benevolent god, but only in gods who make life generally unpleasant. They fear principally a spirit known as Kynemé, but they also very much

respect Pchawcaw, Tchricoong, Incarrycaw, and Tchicomná. The weapons generally used by all three tribes are the bow, with arrows with either hard-wood barbed, bamboo, iron, or bone points, zorauatans (blowpipes), with darts poisoned with ourari (curare), and square clubs. These people make very excellent hammocks of both cotton and fibre.

I lived with Indians of each tribe for several months and found them to be quite docile, though very suspicious in the beginning. Their principal characteristics—and especially this applies to the Macusis—seemed to me to be their curiosity. If given the opportunity they stole small objects, but things of importance were left alone. The fact that I had "civilizados"—Indians who had worked for Brazilians and who therefore spoke Portuguese—as camaradas undoubtedly smoothed my path for me, and after the first month I was always sure of finding food and room to sling my hammock in any malocca.

As a general rule these people are monogamous and fairly moral. Their principal sicknesses seem to be malarial fever, "ferida brava"—a consuming sore not of syphilitic origin—and another disease totally unknown to me which causes fingers or toes to swell, die, and eventually drop off. A form of beri-beri, called by Dr. Oswaldo Cruz, "polyneuritis palustre," is very prevalent in the whole of the Rio Branco regions among Brazilians, but I did not actually see cases of it amongst the Indian population in the savannahs.

Although the lower Rio Branco is extremely unhealthy the campos, taking them all round, are not bad, but one notices that sickness increases as the forest regions are approached. These Indians, though they are, when in good health, fairly muscular, deteriorate rapidly when sick, their constitution evidently having little resistance against fever.

The soil of the campos in the Alto Rio Branco is generally light and sandy and will grow practically nothing with any degree of success, though one finds cajús (cashews) growing wild to a size and quality I have never seen elsewhere. To the north of the hill called Xurawaná the country is considerably accidented, and the soil is of better quality than that further south, this being shown by the richer pasture, and the improved quality of the manioc, bananas, and yams grown in clearings in the patches of forest capping most of the serras. These articles, with fish, game, and some maize, form the diet of the inhabitants.

The hills and mountains are for the most part composed of boulders, some of an immense size, having little earth on the sides, but a larger quantity with forest on top, although some of the larger mountains, such as the Serras de Mel and Banco, Paracaima and Macacao are entirely covered with timber. The mountain known as Oramoreika between the rivers Majari and Parimé, and which forms one of the sources of the latter, is one of the most conspicuous. It is of a sugar-loaf shape and carries very little timber, but is much more imposing than any other elevations in its vicinity. Like most of these hills it rises abruptly from the plain. Its

latitude is 4° 8′ N. At its foot exist more or less ordered mounds of smaller stones, suggesting in shape and appearance generally huge grave-mounds, whilst scattered around are large boulders which make the spot appear as though the gods had been stoning one another—hence the graves.

The tribe I have not mentioned is the Pauxana, which resides in the campos between the rivers Cauamé and Mucujahi. Each tribe has its own language, and none speak the "lingoa geral" or Guarani-Tupi tongue.

The principal forest products to be found in this region, some on the main river and others from the headwaters, are rubber, balata, Brazil nuts, Tonking beans, copaiba oil, and valuable timbers, principally muiripinima (letter or leopard wood). I found colour in my pan in most streams in which I washed for gold. Animal life is plentiful.

The survey of the stretch of country referred to was carried out by me, with the assistance of Adam Harasymowicz, Bernardo Kynchala, and Reubens Higgins, in 1912–13. We were employed by the Superintendencia da Defesa da Borracha (Rubber Defence) of the Brazilian Ministry of Agriculture, of which section Mr. Roderic Crandall was chief engineer. I had in all ten technical assistants of various nationalities at the outset, but the above-named were the only ones who continued throughout the whole work. I also took Brazilian "camaradas" with me, but as they could not, or would not, stand the work, I arranged with some civilized Macusi Indians, and later other Indians "andando de rabo," in their stead. However, with the "civilisados" as interpreters, and picking up a good deal of the native languages ourselves, we progressed fairly well.

At the beginning my idea was to run theodolite traverses along all the rivers, and for some distance this procedure was carried out, but owing to the majority of my assistants returning to civilization I was obliged to resort to meander work with compass and passometer on horseback, checking the runs at the most prominent points and intersections by determinations of latitude. Near the Venezuelan border this work was done on foot owing to the rough nature of the country—very rocky. A triangulation from a small base was also made in order to check the positions of some of the most prominent peaks. Levelling was carried out trigonometrically. All the principal elevations were observed from all sides, and sketch contours made on the spot. Meander lines were run along all igarapés.

The instrument used for latitude determinations was a 6-inch Heyde transit. The longitude was reckoned by account from the junction of the Tacutú and Mahú (Ireng) rivers on the British Guiana border. The co-ordinates of this spot were determined by Messrs. Wilgress Anderson and H. P. Melville of the British Guiana boundary commission a few years ago.

THE POSITION OF SIR ERNEST SHACKLETON'S EXPEDITION.

Hugh Robert Mill, D.Sc.

WHEN Sir Ernest Shackleton left England in the autumn of 1914 it was his intention to proceed in the *Endurance* to South Georgia, to make his way thence through the Weddell Sea to some point on the coast of the Antarctic Continent near Luitpold Land, where he hoped to land with a party and cross the Antarctic Continent to McMurdo Sound on Ross Sea, taking the South Pole by the way, a total distance of about 1700 miles of land travel. He arranged that the *Aurora*, under Captain Mackintosh, should enter the Ross Sea from New Zealand at the same time that the *Endurance* entered the Weddell Sea from South Georgia, and that sledge parties should be sent southward towards the Beardmore Glacier to lay out depôts of provisions for the relief of the trans-continental party.

The *Endurance* left Buenos Aires on 26 October 1914, and sailed from South Georgia in December of the same year. We believe that Sir Ernest Shackleton received a bad report of the state of the ice in Weddell Sea from the whalers at South Georgia, and was led to modify his plans to the extent of deciding to winter the *Endurance* in Weddell Sea during 1915, postponing the great land journey until the Antarctic summer of 1915–16. As South Georgia is in wireless communication with the world (*viâ* the Falkland Islands), no doubt Captain Mackintosh was acquainted with this change of plan before he sailed, but this would make no material difference in the programme of the *Aurora*, which left Hobart on 24 December 1914.

The expedition was one of extraordinary boldness, and had it been planned by any one less experienced in Antarctic conditions and risks than Sir Ernest Shackleton we should have regarded it as rash in the extreme; but Sir Ernest Shackleton has proved himself so far seeing in organization, so capable in emergencies, and so fortunate in his earlier perilous adventures, that we feel sure he, if any man, can command success even here. Writing as we do when any day may bring news of the return of the *Endurance*, we have no temptation to enter into speculations as to the possible progress of the expedition, but whatever the event may prove, it is well to bear in mind that the Weddell Sea has only been navigated to a high latitude on four occasions: by Weddell in 1823, by Ross in 1843 (both in sailing vessels), by Bruce in the *Scotia* in 1904, and by Filchner in the *Deutschland* in 1912. Land was seen by the two last expeditions, but no landing-place was found.

The state and distribution of the ice differed greatly on each occasion, a fact which stands in contrast with the comparatively uniform conditions found in Ross Sea. We should be less surprised to find Sir Ernest

Shackleton returning in the *Endurance* than to find that he had succeeded in landing his party and stores in time to leave for his projected trans-continental journey as he hoped to do towards the end of 1915. So far no news has come from the Weddell Sea, and the news of the other half of the expedition is by no means good.

The *Aurora*, under the command of Mr. Stenhouse, chief officer, returned to Port Chalmers, New Zealand, on 3 April 1916, and we are indebted to a detailed telegram published in the *Daily Chronicle* of April 4 for the following facts: After leaving Hobart the *Aurora* touched at Macquarie Island on December 30 and proceeded next day towards Ross Sea, making an extremely good voyage, arriving at Cape Crozier, the eastern extremity of Ross Island, on 9 January 1915. At this point a quantity of stores was to be landed for the use of the depôt-laying party towards the south—a sound precaution if the route were to be like Scott's last journey along the 170th meridian. This was found impossible, however, owing to the advance of the Great Ice Barrier against the high cliffs at Cape Crozier, and the attempt had to be given up. While it was being made the ship was driven on to a portion of the Barrier, 50 feet high, and lost her jib-boom in the collision. She then proceeded to McMurdo Sound, entrance to which was obstructed by pack-ice until January 16, when a landing was made at Cape Evans, the winter quarters of Captain Scott's last expedition, across 1 mile of fast bay ice. After an inspection of Scott's hut had been made the *Aurora* pushed on towards the south in the hope of reaching the old *Discovery* winter quarters at Hut Point, 14 miles further south, but she had the misfortune to run aground and remained fast for a day. She landed 624 gallons of benzine, 208 gallons of kerosene, and 10 tons of coal at Cape Evans. The message here becomes confused, but it appears that the ship got to within 3 miles of Hut Point. On January 18 Mr. Stenhouse with four men went over the sea ice to Hut Point, and found the hut there snowed up but in good condition. They were detained for three days in the hut by a blizzard, but returned safely to the ship. On January 24 the first depôt-laying party of three men, Joyce, Gaze and Jack, left with nine dogs to lay a depôt at Minna Bluff; and on January 25 a second party, consisting of Mackintosh, Wild and Spencer Smith with nine dogs, left to lay a depôt at Mount Hooper on the Barrier 90 miles south of Minna Bluff.

A third party left on January 31, consisting of Cope, Stevens, Richards, Hooke, Ninnis, and Hayward, with one man-hauled sledge and the motor-tractor drawing two sledges. They experienced initial difficulties, returned to the ship, and left again on February 5, their precise destination not being stated. Cope had reached Hut Point at his first start and found there a letter from Captain Mackintosh stating that he had been obliged to return there on account of bad weather on the sea ice, but had started again and left instructions as to the best way of getting on to the Barrier. The motor-tractor broke down and had to be abandoned near Hut Point.

After an absence of about six weeks, on March 11 Gaze of the first party, Spencer-Smith of the second party, Stevens, Hooke, Ninnis, and Richards of the third party, returned to the ship, having been in the "Bluff locality" with stores. They reported that Captain Mackintosh had reorganized the parties and had left for the Mount Hooper depôt with Joyce and Wild, while Cope, Hayward, and Jack proceeded to the Bluff; but unfortunately no date is given of this departure. On March 23 Stevens, Spencer-Smith, Gaze, and Richards were landed at Cape Evans to carry on scientific observations, and on April 4 Mr. Stenhouse, growing anxious on account of Captain Mackintosh's prolonged absence, arranged for the despatch of a party over the sea ice to Hut Point; but bad weather made it impossible for this party to leave the ship, and this was supposed also to account for Mackintosh and his party not leaving Hut Point, to which Stenhouse appears to have assumed that they had returned. Since 11 March 1915 nothing is known of the southern sledge parties.

After the second departure of the third party on 7 February 1915, when the ship was on the edge of the ice within 4 miles of Hut Point, the *Aurora* returned northward to look for winter quarters, as Captain Mackintosh had given particular instructions that she was on no account to attempt to winter at Hut Point. He had suggested Glacier Tongue, halfway between Cape Evans and Hut Point, and until February 27 Stenhouse made strenuous efforts to find an anchorage in that position; bad weather and the short-handed state of the ship made manœuvring in the ice-encumbered waters extremely difficult, and the vessel was twice driven on to the ice of Glacier Tongue, on one occasion being held there for seven and a half hours by the pack. The *Aurora* then proceeded to Cape Evans, where two spare anchors were embedded in the ice ashore to serve as stern moorings, and as she lay at anchor off Scott's hut the wireless masts were rigged in the hope of being able to communicate with Macquarie Island. On March 10 the anchor dragged in a blizzard and the ship was driven 30 miles to the north-west, narrowly escaping destruction on Barne Glacier as she passed. It was on the next day, when returning to the southward, that she picked up the members of the depôt-laying expeditions; she also landed two months' full provisions for twelve men presumably at Hut Point.

On March 12 the *Aurora* was again anchored at Cape Evans, but once more dragged in a blizzard and, passing dangerously close to Capes Barne and Royds, was swept northwards 40 miles to near Beaufort Island. Next day she returned to Cape Evans where the young ice was rapidly forming on the sea, and on the 14th she was moored by two bower anchors ahead and the two fixed anchors on shore astern. The young ice continued to form and to break away, returning as an overriding pack mounting upon the newer formation. Provisions for over two months or more were landed at Scott's hut, but some stores, including oil and coal, were washed away by the sea raised by the collapse of an iceberg.

The ship was continually dragging her anchors on account of the movements of the ice, though they were strong enough to have held her against any wind in a clear sea. On March 20, feeling that the position was reasonably secure, Stenhouse let down the steam in the *Aurora* and drew the boiler fires in order to economize coal, of which only 118 tons remained out of the original supply of 474 tons. At the same time all sledging rations for next year were put ashore, but next year's supply of clothing was kept on board as the ship continued to be the headquarters of the wintering parties.

As the month of April advanced the ice round the ship grew thicker, the indriving pack frequently produced serious pressures, and on April 23 the sun disappeared for the winter. Heavy blizzards continued and their violence increased until on May 6 the ice parted at its junction with the shore; 2 square miles of it surrounding the ship were held for several hours by the moorings, but at 9.30 p.m. all the stern wires parted, and the ship, fixed in the floe, was blown out to sea breaking away from her bow anchors. The ice packed round the ship to the height of the rails, and steam was got up with great difficulty on account of the sea-cocks being frozen, so that the boilers could not readily be filled. The drift took the ship northward, passing Cape Bird at the extreme north of Ross Island on the 8th. Blizzards continued for some time, but the weather afterwards became normal and the drift set north-east and north at the rate of 2 miles per day. Arrangements were made on May 26 for leaving the ship in case of necessity, sledges being packed with all necessaries for camping on the sea-ice should the vessel be crushed. On May 27 Mount Melbourne was sighted at a distance of 90 miles to the north. The weather was then fine and exercise could be taken on the sea-ice. The northward drift continued until in lat. 76° S., when it changed to eastward, and later to north-eastward, the movements of the ice suggesting that the Ross Sea was open to the eastward. On June 5 open water was seen to the east and north, but during this time heavy pressures were experienced and the ship severely bumped by moving ice underriding the pack. Wireless calls were sent every night to Cape Evans in the hope that the party there had rigged up their wireless equipment, and on June 9 Hooke and Ninnis thought they heard a reply. Weather reports were sent daily to Macquarie Island but no response of any kind was obtained.

On June 22 mid-winter day was celebrated on board; the lack of exercise was now severely felt, as the frequent breaking up of the ice near the ship made it no longer safe to leave the vessel, and considerable difficulty was experienced in obtaining fresh water until on June 26 a fall of 4 inches of snow put an end to that inconvenience. In July the weather became much worse, and on the 18th, when the *Aurora* was somewhere near lat. 75° S. 90 miles from land, the ice split round the ship with a violent shock, and for a week she was in an exceedingly precarious position. On the 21st the ship swung athwart a lane of open water

between ice-floes 10 feet thick which closed in, nipping her bow and stern, bending over the steel-bound rudder weighing six tons and twisting it like a corkscrew, thus rendering it useless. Under the terrific pressure the ship rose and fell amidships with a concertina motion, and at 8 a.m. next day, when the ship had been half raised on to the ice, Stenhouse thought that the end had come; all hands were called to sledge stations in readiness to leave the vessel at a moment's notice. He poured a carboy of sulphuric acid over the stern in the hope of rotting the ice and so saving the stern post. After a terrible day of anxiety the ship crushed back into the ice on the starboard side at 10 p.m.; by midnight she had slewed aslant a lane of open water with the stern post clear of hard ice, and lanes were opening through the floe on all sides. Her position when the imminent danger had passed was 90 miles south-by-east or south-east of Coulman Island. Wireless messages were sent out describing the position, but apparently were never picked up. On July 25 a large field of ice came charging into the floe which held the ship and piled up ice 8 feet thick to a height of 15 to 20 feet. After being cut free at the lower end of the trunk the damaged rudder was safely hauled up on to the ice.

The sun returned on August 6 when the ship was 45 miles east of Possession Island, and on that day also a seal was killed giving a welcome supply of fresh meat as provisions were running low; from this time onward only two meals a day were served. On the 10th the *Aurora* passed close to Cape Adare, the drift now being in a north-westerly direction, and Sturge Island, one of the Balleny group, was sighted to the north at a distance of 90 miles. Cape North was passed, though it is not stated that it was actually sighted. On September 5 the mizzen wireless mast was carried away in a terrific blizzard, but another was rigged and messages continued to be sent without response. Early in October land was sighted far to the south-west in the direction of Oates Land.

As the summer approached and passed hopes of being of any use to the Southern Party that season vanished. Attention was given to biological and other observations, including the ice formations, and on November 17 a sounding was obtained of 190 fathoms with a muddy bottom, but unfortunately the position is not mentioned. At the end of November land was again sighted from a position north-west of Oates Land. About Christmas ice of extraordinary thickness was observed, the water in lanes near the ship being in places 25 to 30 feet below the ice-surface. This is caused by floes underriding the pack. The telegram becomes less intelligible towards the end, dates and positions being rarely mentioned; thus we are not informed how the rudder was replaced, nor at what date the ship ceased to be carried along in the ice. Reference is made to the ship being gradually worked northward and to lanes becoming more open and more numerous before 12 February 1916, when the ice is stated to have broken up and the ship set sail, but no hint is given as to

the position where this occurred. On March 10 the *Aurora* had a narrow escape of being crushed between two icebergs, and on the 14th, after passing through heavy pack, she cleared the ice in lat. 64° 27½′ S. and long. 161° 16′ E. This is the same place, and only eight days later than the date at which the *Terra Nova* cleared the ice in 1911 on her return from landing Captain Scott.

On March 22 wireless communication was at last established with the Awarua station at Hobart, but not with Macquarie Island. The Otago Harbour Board sent a message offering hospitality and announcing that a tug would be sent to meet the *Aurora* off Stewart Island, and in tow of this vessel the *Aurora* reached Port Chalmers on April 3. The most interesting feature in the drift is the extraordinarily rapid movement throughout the winter months and the slow movement in the summer. The positions and dates given in the telegram are not precise enough to afford more than the roughest approximation to the track of the ship, but we deduce from them the following figures: The drift from May 6 to 24 July 1915, mainly south of 75° S., was about 200 miles in 79 days, or at the rate of 2½ miles a day. Between 75° and 72½° S. the drift of about 150 miles from July 24 to 6 August 1915 occupied 13 days, being at the rate of 11½ miles per day and the drift of about 60 miles from August 6 to 10 took only 4 days, being at the rate of 15 miles a day. The north-westerly drift towards the Balleny Islands amounted to about 250 miles in 26 days from August 10 to 5 September 1915, at the rate of 9½ miles per day; while the final 250 miles of northing from 5 September 1915 to 14 March 1916 occupied 191 days, at the rate of only 1⅓ mile per day. No particulars are available as to the movements of the vessel in the last period, and her actual course must have been very much longer.

As regards the condition of the party left in the south by the *Aurora*, Mr. Stenhouse makes it perfectly clear that they are provided with abundant stores of provisions, both at Cape Evans and Hut Point. Apart from the long isolation the four men at Cape Evans may be looked upon as suffering no more inconvenience than is usual on Antarctic expeditions. If the two southern parties of three men each succeeded in returning to Hut Point from the Barrier, they also would find themselves in safe and comfortable quarters, only 14 miles from Cape Evans, and no doubt they would be in communication with each other before last Christmas.

The non-return of Captain Mackintosh and his party before the winter of 1915 set in must of course give rise to some anxiety, but from the information available there is no need to anticipate disaster. A relief expedition should, of course, be sent out in November or December of this year, and probably it would be wise not to dispatch it too early in the season, as that is only likely to result in a long and slow progress through the pack. The voyage to Cape Evans and back, if the *Aurora* is found sufficiently seaworthy to be employed again, is a very simple affair and will, we hope, result in bringing back not only Captain Mackintosh and

his men, but Sir Ernest Shackleton and his trans-continental party also. Real difficulties, however, both in plan and execution will have to be faced if no news of the *Endurance* should arrive. A suitable ship for a voyage through the Weddell Sea may not be easily found, and there is no specific point towards which she could make her way with any certainty of finding news of the missing Expedition. The *Endurance*, if she had succeeded in withstanding the ice-pressure in the Weddell Sea for two years, may have drifted into any part of that great unknown area, or she may have been shut in against any part of the practically unknown coasts of Coats Land, Luitpold Land, or beyond. It seems to us that a relief expedition to the Weddell Sea must be hampered by no restrictions beyond the simple instruction to its leader to do his utmost to discover and relieve the missing explorers. There are very few men fitted to take charge of such an expedition, and if one of the few can be secured his chance of success would depend upon his having a free hand to act as he sees fit in the circumstances as they arise.

At the meeting of the Society on April 17, the President referred to the news of the mishap to the *Aurora* as follows :—

I am sure you will expect me to make some reference to the news from the Antarctic which has reached us since our last meeting. As you may have seen in the evening papers the *Aurora* has arrived to-day at Port Chalmers, and through the courtesy of Sir Ernest Shackleton's representatives in this country I have here a summary of a telegram that has been received from her which will no doubt be published in the papers to-morrow.

(The President then read the summary referred to.)

It would seem, I think, though one has not had time to consider the case fully, that Captain Mackintosh's party, which left at the end of January, had not returned to the ship before it drifted off early in May, and this must be a cause of some anxiety. Of course it is too early, with the imperfect information before us, to suggest or to formulate any plans for the future, and even when we have the full accounts from the *Aurora* we shall only be informed as to part of the problem. For there remains the question whether the *Endurance*, the ship that has gone to the Weddell Sea, will come back this spring. It may do so at any time up to the beginning of May, and it is possible that it may bring back the whole of Shackleton's party. The season has been a bad one in the Antarctic, and it is very uncertain whether he has been able to effect a landing or, if he has, whether he will find the region on that side of the Pole negotiable and be able to carry out his bold scheme of pushing right across it. Should the whole party return from the Weddell Sea, the problem of relief will be greatly simplified. In any case the men from the *Aurora* who have been left behind in the Antarctic have to be fetched; but we may hope that it may be possible to repair the *Aurora* herself and to use her for this purpose. Should a second relief expedition be required from the Weddell Sea side, the matter will be a much more serious one. It is a satisfaction to learn that the men who are the best able to give advice to Sir Ernest Shackleton's representatives as to the proper steps to be taken will be in this country or near at hand very shortly. I refer to Sir Douglas Mawson, Captain Davis, and Commander Evans. We must rely on them to indicate the right course to be adopted in

the circumstances. Meanwhile we shall all hope for the best and look forward to the return of the expedition safe if not successful. I do not think, as far as I, who am no expert in these matters, can judge, and as far as those who are experts can advise me, that there is any grave additional risk to Shackleton's party involved in our recent news. There appears reason to believe him to have started with provisions sufficient to take him across the Continent, even if not met till he got to Hut Point. The only great inconvenience, therefore, that would be caused would be his having to spend another winter in the Antarctic before he was rescued.

REVIEWS

A Vagabond Voyage through Brittany.— Mrs. Lewis Chase. London: Hutchinson & Co. 1915. Pp. vii., 316. *Map and Illustrations.* 7*s.* 6*d.* net.

IN this book Mrs. Chase tells the story of an "inland voyage" by herself and her husband through the heart of Brittany. They bought a small rowing boat and followed the wonderful canal system from Dinan, near St. Malo, south and west *viâ* Rennes, Redon, and Pontivy to Chateaulin, near Brest. The distance from St. Malo to Brest by this route is 510 kilometres (317 miles), and the number of locks is no fewer than 280. In making such a voyage Mr. and Mrs. Chase found that they were in the nature of pioneers. They usually put up at night with the lock-keepers, and the book affords some interesting glimpses of the home-life of these people. It is to be noted that though the trip was made before the war the travellers carried authorization papers from Paris, and their coming was known all along the route. Many charming photographs by Mrs. Chase illustrate the quiet rural beauty of the districts traversed.

Portugal and the Portuguese.— Aubrey F. G. Bell. London: Pitman & Sons. 1915. Pp. xiv., 263. *Illustrations and Map.* 6*s.* net.

This book forms one of the Countries and Peoples series published by this firm. Only sixteen pages are devoted to population and employment (in which is included a short account of products), and there is no connected geographical description of the country, though the careful reader can glean here and there isolated facts of interest. Much of the book deals with the characteristics of the Portuguese, life in town and country, and noted convents and palaces; but the greater portion is occupied with history, literature, and politics. Unfortunately the historical survey is too short to be of much value. There is an interesting chapter on the relations of Great Britain and Portugal, and another on Portugal of the future.

Constantinople, Old and New.— H. C. Dwight. London: Longmans, Green & Co. 1915. Pp. xiv., 555. *Illustrations.* 21*s.* net.

The normal life of Constantinople is well described, and there is a profusion of excellent illustrations. An interesting chapter treats of Old Constantinople, but rather less space is given to historical than to modern aspects. The author gives detailed accounts of the revolution in 1908, the capture of Constantinople in 1909, and of the city in war time, 1912–1913.

Storied Italy.— Mrs. Hugh Fraser. London: Werner Laurie. 1916. Pp. 344. *Illustrations.* 12*s.* 6*d.* net.

A series of disconnected essays and sketches, containing impressions of scenes in mediæval and modern life. Among the studies are "A Roman Christmas," "Santa Susanna," "Signora Pistocchi," and a "Fairy Tale and an Earthquake."

ASIA.

Japan, the New World Power.— R. P. Porter. London: Humphrey Milford. 1915. Pp. xlix., 771. *Maps.* 6*s.* net.

This is a re-issue of the work which first appeared under the title of 'The Full Recognition of Japan,' and was reviewed in the *Geographical Journal*, March 1912. It contains an introductory survey of Japan's share in the Great War, and has been generally revised and brought up to date where necessary. The author emphasizes the disadvantage under which the Russians lay in the war with Japan on account of their limitation to a single line of railway. This was largely responsible for the ultimate success of Japan, in spite of the fact that at that time the Japanese had not reached their present state of readiness for war.

The physical characteristics of Japan are very briefly dismissed, but a detailed account is given of occupations and of the state of emigration. Unfortunately the census of 1915 is not yet available. The average annual number of emigrants is 200,000, half of whom go to China and the United States, and the other half to the Sandwich Islands, the Philippines, the South Sea Islands, and South America. The cause of the constant emigration seems difficult to determine, as the majority of emigrants do not come either from the poorest or the most crowded districts of the country. A full account is given of the training in the Technical Schools, the thoroughness of which has largely contributed to the industrial progress of the country and to the important part that the Japanese are now taking in the production of munitions.

Agriculture, forestry, and mineral production are dealt with in considerable detail. Japan is poor in iron ore but relatively rich in what is technically called sand-iron, with regard to which certain important and successful experiments have lately been made. The author makes various criticisms on the methods employed in Japanese factories and especially notes the want of specialization in machine construction. This he attributes mainly to the absence of sufficient skill in manufacturing on a large scale. He has however a sanguine belief in the great industrial future of Japan. A most useful portion of the book is that in which he deals with the Japanese development of Korea, Formosa and Manchuria. A full account is given of the soya bean in Manchuria, which is proving very valuable for the extraction of oil and the manufacture of food for cattle as well as for vermicelli and other products.

On the whole, this book should prove useful for reference to all interested in the progress of Japan, though it is written in a somewhat unreadable style.

A. W. A.

An Official Guide to Eastern Asia.— Published by the Imperial Japanese Government Railways. Vol. 1. Manchuria and Chōsen. Vol. 2. South-West Japan. Vol. 3. North-East Japan. Vol. 4. China. Tōkyo. 1914–15. $6\frac{1}{4} \times 4\frac{1}{4}$ inches. *Maps, Plans and Illustrations.*

This series essays to dethrone Murray and Baedeker, so far as the Japanese Empire and East Asia generally are concerned, and it seems likely to

accomplish the feat. For the visitor who knows English there has been for long Murray's excellent handbook to Japan, the work of a succession of well-known scholars, and more recently there is Terry's Guidebook in addition; but the last Baedeker published just before the war broke out was the only reliable comprehensive attempt of late years to introduce the tourist in the comfortable European fashion to the East Asiatic mainland. In 1908 Baron Goto, the Minister of Communications and President of the Imperial Government Railways of Japan, set to work to remedy the want as regards the Chinese Empire and Korea, and to complete the earlier work on Japan, and a committee of experts was appointed, of whose labours the four volumes above mentioned are the fruits up to date. The first, Manchuria and Chōsen, was published from the Tōkyo Tsukiji Type Foundry in October 1913, five years after the committee was appointed; the second and third, comprising the whole of Japan, Formosa, the Lu-chus, the Kuriles, and Sakhalin (Karafuto), in July 1914; the fourth volume, China Proper, in June 1915; and we are told that a fifth on the East Indies will appear shortly. No expense or trouble has been spared to make these the last word in guide-books to East Asia up to the date of their appearance. The printing of the text (brevier) and notes (nonpareil), and the illustrations, maps and plans could hardly be improved upon; the information is thorough and goes beyond the usual limits in ministering to the wants of business men as well as tourists; the volumes are handy and compact.

The preface to Vol. 1 warns us that "places in the colonies of Japan are all represented by their Japanese names instead of the native terms," but it is not everybody who will recognize the centuries-old Korea or Corea in Chōsen, which is the Japanese pronunciation of the last Chinese and Korean name, Ch'ao-hsien, in Korean Chosŏn, commonly translated "Morning Calm." Nor again is it easy for old denizens to identify many of the Korean place-names. In a number of cases the names familiar to Europeans are added—*e.g.* Gishu (Wiju), Teishu (Chungju), Heijō (Pingyang), Kaijō (Songdo), Keijō (Seoul)—but the practice could be extended with obvious advantage to the European traveller, for it must take some years yet to make the new Japanese names current amongst the Korean people, few of whom are familiar with the Japanese language.

Vols. 2 and 3 are in some respects an advance on Terry and the last Murray, and there is a more distinctly Japanese flavour about them. The China volume, 4, has had no predecessor of the same quality. The introductory chapters, especially that on Chinese art, are excellent, and so far as railways and steamers can carry the visitor the routes are amply described.

C. W. C.

POLAR REGIONS.

Report on the Scientific Results of the Voyage of S.Y. "Scotia" during the years 1902, 1903, and 1904, under the Leadership of William S. Bruce, LL.D., F.R.S.E.— Vol. 4. Zoology—Vertebrates. Edinburgh, 1915. Pp. xi., 505, 64 pls.

Owing to the enlightened generosity of Sir Thomas Glen Coats Antarctic literature is enriched by this valuable addition, which brings conveniently into one volume an important series of memoirs on the zoological collections made during the Scottish Expedition under Dr. Bruce. It is entitled the 'Vertebrates,' but it includes the Tunicates, which are described, with one new species, by Prof. Herdman, and also *Cephalodiscus*, which though having strong claim for consideration as a chordate is hardly a vertebrate. This very

interesting animal is described in a valuable memoir by Dr. Harmer and Dr. Ridewood, which includes a full statement as to the classification of the known species and adds a new one. As the authors remark, the genus has its headquarters in Antarctic and sub-Antarctic regions. The volume includes a series of contributions upon the anatomy of the seals by Prof. Hepburn, Dr. Thomson, Mr. Haig, Dr. Rudmose Brown, and Dr. Bruce. The ornithology includes interesting accounts of the anatomy of the penguins by Dr. Waterston and Dr. A. C. Geddes, who suggest that Huxley's genus *Palæeudyptes*, which was founded on a fossil penguin from New Zealand, is unnecessary. From work on the embryology of the penguins they discuss the relative ancestry of these birds and the ducks, and conclude that the penguins have descended from a primitive bird that could fly though very clumsily.

The longest contribution is that on the general ornithological work of the expedition by Messrs. Eagle Clark, Ramsay, Rudmose Brown, and Bruce. It is illustrated by four artistic coloured plates by Mr. Goodchild and two maps giving the range of the species observed.

The memoir by Mr. Tate Regan on the fish is perhaps of the most general geographical interest owing to the evidence they afford as to former geographical conditions. Mr. Regan is emphatic that, as this fish fauna is of a very specialized Antarctic type, it give[illegible] support to bipolarity; he shows that an extensive cold Southern Ocean has existed through the greater part of the Kainozoic, and that the fish throw no light as to the former northern extensions of Antarctica. He refers again to the evidence of *Galaxias*, which, owing to its occurrence in the rivers of South America and Tasmania, was long thought to be one of the strongest arguments for a recent land connection between those regions. As pointed out by Mr. Boulenger, the discovery that *Galaxias* breeds in the sea destroyed this argument, and Mr. Regan shows that this fish was originally marine and is now extending its range to fresh waters. The Cetacea are described by Dr. Bruce, who has wisely included in this volume a most interesting account by Mr. Salvesen of the whale fishery of the Falkland Islands and its dependencies. Dr. Bruce remarks in the preface that this important industry, at present the most extensive whale fishery in the world, is the result of the voyage of the *Scotia* which discovered the abundance of whales in this region. He tells us that "Before the *Scotia* sailed there was not a deep sounding taken south of lat. 40° S. in the Atlantic Ocean. The South Orkneys and South Shetlands were practically unvisited, and almost entirely unknown. South Georgia was little known. Now over a thousand people live under the British flag in South Georgia, and the South Orkneys and South Shetlands are a busy hive of industry during the summer months. Traders have even turned their attention to the west coast of the mainland of Graham Land, a direct result of the scientific expeditions sent out by Belgium and France, and altogether over a million pounds sterling of gross annual revenue is now taken in these regions previously considered worthless by business men."

J. W. G.

GENERAL.

The World we live in.— Edited by Graeme Williams. Vol. 1. Pp. 233. London: The Waverley Book Co. *8s. 6d. net.*

This popular work consists of a series of disconnected essays by notable contributors with suitable diagrams and illustrations, and a number of other illustrations of great interest in themselves yet adventitious to the text.

The book lacks cohesion ; for example, Mr. Arthur Holmes supplies consecutive but disconnected essays on "Ocean Currents and Tides" and "Climate and Weather," and Mr. S. L. Bastin deals largely with the climatic control of vegetation in an essay on the "Distribution of Plants," yet makes no reference to the essay on Climate. The essays are unequal ; for example, Sir H. H. Johnston contributes an interesting magazine article on "How Geography affects History," and follows it with a more complete description of the "Distribution of Animals" and an illuminating essay on "The Distribution of Man ;" while Mr. Holmes is frequently abstruse and highly technical in his geological essays on "The Making of the Earth," "The Oceans and Continents," and "The Distribution of Mineral Wealth." He discusses the planetismal hypothesis, assumes the tetrahedral theory, and describes the origin of coal, yet in the essay on Climate he dismisses the intensely human and therefore geographical problem of the Nile flood in an illuminating sentence. Mr. R. J. Finch is enthusiastic in his contribution on "Trade and Transport," and, consequently, his general statements such as "Transportation is, in effect, a safe measure of a nation's efficiency" are too sweeping to carry conviction. Mr. A. R. Hinks summarizes effectively the chief points of general importance in the essay on "Maps and Map Reading." Out of touch with nearly every essay in the book is Prof. Lyde's introduction in which he summarizes his well-known views on the teaching of geography. One wonders how many of the subsequent pages Prof. Lyde would include in a geographical course for schools.

B. C. W.

Visits to Monasteries in the Levant.— The Honourable Robert Curzon, Junr. With an introduction by D. G. Hogarth. London : H. Milford. 1916. *2s. 6d. net.*

This reprint of a well-known travel book of the early nineteenth century is entirely to be welcomed, as the book is well worthy to be so perpetuated, while no previous edition has been in print within recent years. The style in which it is produced is thoroughly satisfactory, for in spite of the moderate price it is in clear type, on good paper, and yet of a size that makes no excessive demands on space in a library. The original woodcut illustrations are reproduced. Mr. Hogarth's introduction supplies just the help needed by the general reader towards a just appreciation of the quality of the book and the circumstances which led to its being written. A comparison with the classic example of Kingslake's 'Eothen' (a reprint of which was brought out in the same style and under the same auspices in 1906) is, he shows, for once really justified, for there is much in the temperament and point of view of the two writers that is similar, though Curzon's production can hardly claim the same approach to literary perfection as the other work. As a book of travel it may even be preferred, as the field covered was wider, the adventures were more exciting, and the time spent by the author in the Near East was far longer. The style, though less elaborate, is not less attractive than Kinglake's, and Mr. Hogarth does not hesitate to say that in narrative and description it will bear comparison with any book of travel. The publishers deserve the thanks both of geographers and of the public for having made it once more generally accessible. To the bibliophile it has a special attraction in connection with the literary treasures of the monasteries, the examination of which was a principal motive in the journeys.

THE MONTHLY RECORD.

EUROPE.

The Italian Earthquake of 13 January 1915.

PROF. E. Oddone has contributed an elaborate study of the Avezzano earthquake to the Italian Seismological Society ("Gli elementi fisici del grande terremoto Marsicano-Fucense del 13 gennaio 1915," *Boll. Soc. Sismol. Ital.*, vol. 19, 1915, pp. 71–215). He confines himself in this memoir to its nature and effects within the epicentral area, the seismographic records being reserved for another paper. The map which he gives, which is on a very small scale, shows the isoseismal lines of intensities 9-12 of Cancani's duodecimal scale. The outermost of these lines consists of two branching lobes, the axes of which are slightly inclined to one another on either side of the north-west—south-east direction. The northern area, which is the more important, the intensity within it being as high as 12, occupies the basin of the old lake of Fucino, and extends about 20 miles to the south-east of Avezzano as far as Lecce. The southern area, within which the intensity does not rise above 11, spreads along the Val Liri as far as Sora. Prof. Oddone does not, however, consider that there are distinct foci corresponding to these two areas, but that their separation is due to orographic and geological conditions. On hilly ground and compact rocks the damage was usually small. It was in the deeply excavated valleys that towns and villages were greatly injured. Prof. Oddone has made a careful study of the directions of the shock within and near the epicentral area. These directions diverge, not from a single point, but from a definite area within the innermost isoseismal line, an area which is only a few miles in length, and is elongated in the north-west—south-east direction. Its centre is in 41° 58′ N. lat., 13° 36′ E. long., or about 10 miles to the south-east of Avezzano. As usual in great earthquakes, the ground within this area is strongly fissured. There is also, however, a remarkable perimetral fracture, which follows roughly the course of the isoseismal 12, and includes the epicentral area mentioned above. With a few interruptions Prof. Oddone has traced this fracture for a length of 40 miles. It varies in width from 1 to 3½ feet, and the side of the fracture towards the interior of the curve is invariably depressed by an amount ranging from 1 to 3 feet. The estimates of the depth of the seismic focus vary considerably with the method employed to determine it. One reason for this may be that the focus was of considerable dimensions in a vertical direction. Prof. Oddone regards about 6 miles as a probable value of the depth.

Lakes of the Northern Apennines.

The fact that lakes exist in the Northern Apennines is perhaps not generally realized, and little account has been taken of them even by Italian limnologists. This is no doubt due to their small size, which seems to give, even to the largest, the character of mere mountain tarns. That they may however be worthy of study appears from an article in the *Rivista Geografica Italiana* (November-December 1915), by G. Anfossi, who, as a preliminary aid to further work on the subject, has compiled a list of 108 such lakes (some of them, however, hardly more than ponds), stating their position, altitude, and area, and referring to the few attempts at scientific examination yet made. In his introductory remarks he draws attention to some interesting facts regarding their distribution, both horizontal and altitudinal, which the compilation of the

lists has brought into notice, and which he illustrates by sketch-maps and diagrams. Almost all the lakes occur in three main groups, between the Trebbia in the west and the Reno in the east, with a fourth minor group much further east about the headwaters of the Marecchia. In each group there is a lesser area in which the density is greatest (called by the writer the nucleus), and a wide marginal area in which the lakes are fewer. The greater number in all cases occur on the northern side of the water-parting. Altitudinally, the greater number in each group occur within a belt of 100–200 metres, higher or lower as the case may be, but generally lying between 1100 and 1600 metres, though comparatively few are found between 1400 and 1500 metres. Although detailed studies on the spot are needed before their mode of origin can be pronounced upon with confidence, the facts of distribution justify the conclusion that it is for the most part due to former glaciation, the "nuclei" corresponding generally with the areas in which morainic deposits are most in evidence. The "marginal" sections, generally at a lower altitude, are rather to be associated with landslips. The writer does not venture a positive opinion as to the relative importance of excavation or morainic obstruction as the most active agent in the formation of glacial lakes, but strongly inclines to the latter, in accordance with the view of those who attribute in the main a conservative action to the ice, which, it is held, merely occupied and modified pre-existing hollows. The mere presence of the ice would tend to preserve these from being filled by *débris* due to landslips or by other products of degradation. A protective action of this kind might surely, as has been suggested before in the *Journal*, help to explain many of the facts of "overdeepened" and hanging valleys, without extreme recourse to the supposed excavatory action of the ice.

ASIA.

The Sakurajima Eruption of 1914.

The Rev. Walter Weston sends the following note on a report (in Japanese) issued by the Japanese Military Survey Department on the 'Topographical Changes and Movements of the Ground in the Prefecture of Kagoshima, caused by the eruption of Sakurajima in 1914,' supplementing it from his own observations: "The eruption of the volcano locally known as Mitake ('the August Peak') which stands on the island of Sakurajima ('Cherrytree Island') in the centre of the Bay of Kagoshima, in Southern Japan, took place in January 1914. The peak rises to the height of 3700 feet from the water's edge, and since 1779 had ceased to be active, although when the present writer made the first recorded 'foreign' ascent over twenty years ago there were strong fumes of sulphur noticeable in the highest crater. The island itself, with a population of 21,000 dwelling in 3500 houses, has been reduced to a desert, and its trade in oranges, vegetable wax, and *daikon* (the giant radish) practically wiped out. The city of Kagoshima itself, on the mainland, at a distance of about 5 miles, was damaged to the extent of £50,000, but only 35 lives were lost, and it is believed that more of the deaths were due to the stampede from the city at the beginning of the eruption than to the disturbance itself. Amongst the recorded results of the eruption and the earthquakes which accompanied it is a general subsidence of several feet over nearly the whole island, especially on the north, while the lava outflow has practically dammed up the south-east channel of the Bay of Kagoshima and connected Sakurajima with the mainland. Off the north coast of the island—now an island no longer—one small islet, Doroshima, was wholly submerged, another, Nakanoshima, partly so, while three others are visible only at low tide. On Sakurajima itself the village of Takemura was partly

overwhelmed by a lava-stream with a thickness of 6–10 feet. One of the most remarkable features was the appearance of the great tongue of molten lava slowly sliding into the sea on the south-west of the island, together with the enormous masses of sulphurous vapour which rose several thousand feet from the newly formed craters. In regard to this eruption my friend Dr. Omori, Japan's most distinguished seismologist, told me he had warned the Governor of the Prefecture of Kagoshima the previous year that trouble was to be expected, owing to the signs of activity shown in the Kirishima Peaks (some 30 miles to the north on the mainland) which belong to the same volcanic vein. The Governor, he said, passed on the warning to the Prefectural Assembly, urging them to purchase the necessary seismometer which would afford timely warning of impending disaster. They declined, however, to spend the needed £14 on the instrument, and were themselves therefore, he considered, mainly to be blamed for much of the sufferings and loss that ensued. There is an excellent observatory at Kagoshima—similar to those scattered all over the country, which have often proved of great practical value—but the particular instrument in question was lacking."

AFRICA.

Railways in Nigeria.

With reference to Sir Charles Metcalfe's paper on the railways of Africa in the January number, Mr. H. S. W. Edwardes calls attention to proposals for the future as regards Nigeria, which, he says, it is generally understood will be carried out on the successful completion of those spoken of by Sir Charles as actually under construction. They provide for an extension of lines serving the main trade-routes, viz.: (1) from above Jebba to Yelwa above the Bussa rapids, and thence to Sokoto; (2) from a point on the new eastern line to Bukum, and thence to Bauchi and Maiduguri; (3) from Kano to Zinder in French territory. Mr. Edwardes remarks that the northern provinces of Nigeria contain 3,000,000 head of cattle, and that their soil is peculiarly suited to ground-nuts, of which enormous crops are raised by their seven million inhabitants. Given adequate transport facilities and enlightened commercial methods, the country, he says, will prove one of the great sources of food-supplies.

Early Knowledge of Central Africa.

Since the notes on this subject in the March and April numbers were written the first numbers for 1916 of *Petermanns Mitteilungen* have been received, and it happens that the whole subject is there discussed in a series of articles by T. Langenmaier, illustrated by a large number of sketch-maps. The writer gives evidence of wide knowledge and careful study of the whole series of early maps, and is therefore fully alive to the general course of their development. It is therefore the less intelligible that he should lend himself in some degree to the popular misconception by endeavouring to trace evidences of actual knowledge in a few chance resemblances of names or rough approaches to representation of features as we now know them. Still the study is of value for its concise marshalling of facts, though their true application seems sometimes missed. There is an elaborate discussion of the precise way in which Ptolemy obtained his fixed positions, and of how errors crept in, but surely his data were in any case too vague to justify such minutiæ. The author regards Ptolemy's two lakes as the Victoria Nyanza and *Tanganyika*, assuming that knowledge of them was obtained from the *east* coast. But the chief account of the Nile is given from the *north*, and it seems conceivable that its

lakes may represent nothing more than the two flooded areas of the Bahr el Ghazal and Sobat, the first of which is allowed by Herr Langenmaier to have been the basis for the Lake Kura of the Arab geographers. The Snowy mountains were certainly heard of from the east, but their association with the lakes of the Nile may be merely an assumption of Ptolemy's. As regards later times the attempted explanation of Waldseemüller's Lake Sacaff (here again read as *Saraff*) and its northward effluent as Lake Nyasa and the Upper Congo (Nyasa merely because *later* maps showed the Zambezi as a second effluent) is surely fantastic. No account is taken of the characteristic curve which identifies the river with the Blue Nile (also pointed to by the associated Abyssinian names), and the author misses the evident parallel between this map and Fra Mauro's—though his sketches of the two are side by side—which last equally misplaces the Blue Nile sources to the south-west, as he himself recognizes. Berlinghieri's much earlier mention of "Lake Saaph" and Behaim's of "Saraff"—both associated with the Nile sources—have escaped him. Equally illusory appears the notion that traces of the Kagera feeder of the Victoria Nyanza and of the country of Karagwe can be found in the maps of Waldseemüller and Mercator—associated, be it observed, with the western, not the eastern, headstream. The attempted identifications of places mentioned in the fictitious narrative of Von Harff are venturesome, though the most obvious of all—that of Gargisa (or Aghissa) with the important caravan centre of Hargeisa in Somaliland—is missed. On the other hand the explanation of the misplacement of Abyssinian names as due to an initial mistake in the placing of Gojam is ingenious, it being shown that most of the other names stand in correct relation to this.

AMERICA.

Rainfall of the United States.

In Vol. 43, 1915, of the *Monthly Weather Review*, Mr. B. C. Wallis in a series of papers discusses the rainfall *régime* of different parts of the United States, and also the economic aspect of the subject in relation to agriculture. For the cartographic representation of rainfall Mr. Wallis has employed Dr. Angot's method of "equipluves" or rainfall "isomers" as they have been styled in this country, which are lines denoting equal departure from a certain standard or "norm," the latter expressing the amount of rainfall which would be precipitated at a given place in a month or other period on the assumption that rainfall were evenly distributed throughout the year. These equipluves expressed in percentage values of "pluviometric coefficients" have been found to possess certain advantages for some purposes over the more familiar "isohyets" expressing the actual quantity in inches or millimetres of rainfall. In a paper reviewing the rainfall *régime* of the Union as a whole Mr. Wallis shows cartographically how the country may be partitioned into separate areas with distinctive characteristics as regards the seasonal distribution of rainfall—much in the same way as the seasonal peculiarities in the British Isles have been portrayed by Dr. Mill and Mr. Salter (cf. *Geog. Journal*, June 1915, p. 520). Thus in the far west there is a section embracing all California, with western Washington and Oregon, characterized by a single maximum in the winter (pl. coeff. 205 in January), and a summer minimum (pl. coeff. 11 in July). The section next to this a little farther east has a principal maximum in the winter, but also a secondary maximum in the early summer (May). A large section in the north central part of the country embracing the states of Minnesota, Montana, Iowa, etc., shows a single maximum in summer (200 in June), and a winter minimum (39 in January); whilst a similar region just east of this differs

in having a secondary maximum in autumn (September). Various other sections of the country show less simple features which cannot here be discussed in detail, but it may be remarked that New England lies in an indeterminate region of small variation, and that Florida exhibits some tropical features. The relationship between total annual precipitation and the seasonal range of intensity as indicated by the equipluves is interesting. Down the middle of the country, for example, where the rainfall is high in the summer (following the sun), the range decreases with increasing fall, whereas in the far west with a high winter rainfall controlled by Pacific influences, the range increases with a decreasing fall on the coast, but both decrease together inland. On the eastern coast the conditions are quite different, both rainfall and range increasing together. It is evident that an extensive country like the States offers an interesting study to those endeavouring to understand the diverse physical factors which control the geographical and seasonal distribution of rainfall. With regard to total annual precipitation the highest figure given is 57 inches for southern Mississippi and the lowest 6 for eastern Colorado.

Fishing-Grounds off the Coasts of Oregon.

The United States Bureau of Fisheries, which shows a praiseworthy energy in promoting the development of the fishery resources of the waters in which it is concerned, in 1914 undertook an investigation of the fishing-banks off the coasts of Washington and Oregon, with a view to ascertaining the possibilities which might exist of successful commercial exploitation. The results are described in Document No. 817 of the Bureau, printed at Washington last year as Appendix VII. to the report of the U.S. Commissioner of Fisheries for 1914. For a number of years—from about 1885 onwards—spasmodic attempts have been made to institute fisheries off the coasts in question, but although fair catches of halibut—the species looked upon as most likely to offer paying returns—were made in isolated cases, the difficulties and uncertainties of the undertaking seemed such as to leave little hope of the development of a lucrative fishery. The investigations of 1914, carried out partly on board the Bureau of Fisheries steamer *Albatross* (which had made a survey of the banks so far back as 1888-89), and partly by inquiry at the Oregon coast towns, seems to have put matters on a somewhat different footing, and to have offered some prospect of success in the future. During the survey trips of the *Albatross* definite information was obtained as to the location and extent of the fishing-banks, the nature of the bottom at various points, the abundance of fish on the banks, and the time of their appearance. That concerned with the character and topography of the bottom is embodied in charts which accompany the report. Although the first indications appeared by no means favourable, a good run of halibut was at last found within an area of 250 square miles off the town of Newport. It attained its maximum in August and September, but a profitable fishery could be conducted in June and July, or even earlier. Weather conditions and the lack of shelter (two of the main obstacles to success in the past) will restrict fishing in any case to the period from April to September, while the absence of storage, transport, and market facilities must continue to hamper operations on a large scale. The whole Oregon coast affords an abundance of the smaller flat fishes, red rock cod, etc., which may form a source of supply in the future.

A Flowering Plant under Eighteen Fathoms of Sea-water.

A short article in *Science* for 18 February 1916, by H. H. M. Bowman, calls attention to a remarkable case of adaptability to unusual conditions exhibited

by two species of sea-grass (*Halophila*) found growing in the Gulf of Mexico at depths of 16 to 18 fathoms below the surface. The species in question are the only ones of this genus (of the order *Hydrocharitales*) to be found in the western hemisphere, in the tropical waters of which they have a limited range. The larger and more widely distributed (*H. Engelmannii*) is a delicate plant creeping over the muddy bottom and rooting at the nodes by white fibrous roots. The clearness of the water no doubt permits sufficient light to penetrate for the synthetic activities of the plants, though as the genus is generally found growing in much shallower water, the writer suggests that it has gradually accommodated itself to present conditions during a slow depression of the sea-floor, such as has been thought on geological grounds to have occurred in the region of the Florida Keys in recent times.

GENERAL.

Edward Wright and his Sea-chart of 1599.

The services of Edward Wright for the improvement of cartography and navigation in the Elizabethan age have been widely recognized, but we still lack a thorough investigation of his whole output from this point of view. While his elaboration of the theory of Mercator's projection and his probable part in the production of the general map associated with Shakespeare's *Twelfth Night* are often spoken of, little has been said about the sea-chart illustrating the voyage to the Azores which accompanied the first edition (1599) of his 'Certain Errors in Navigation,' and strangely enough it has been left to a German writer, Prof. Hermann Wagner, to supply an appreciation of this from the point of view of cartographic technique. In *Petermanns Mitteilungen* for December 1915 he has an article in which a tribute is paid to the importance of Wright's work, and especially of this sea-chart, of which he gives an excellent full-size facsimile. (The chart was reproduced on a somewhat smaller scale in Maclehose's edition of 'Hakluyt's Voyages,' but merely as an illustration of the Earl of Cumberland's voyage to the Azores there described, and with but a few lines of comment.) Prof. Wagner considers this chart of even greater importance to the history of cartography than the general map, and remarks that it is probably its excessive rarity that has prevented the fact from being more generally recognized. Although the text of 'Certain Errors' makes no definite mention of the chart, there is abundant internal evidence to establish Wright's authorship. It is a fine specimen of copper-plate engraving, and measures some 20 inches by 15, the scale being larger than that of other charts of the time (about 1 : 5½ mill. in the lowest latitude). A long legend in the top left-hand corner discusses the new projection, and also the basis for fixing the longitude of the Azores, a point to which Prof. Wagner devotes special attention as of great importance for the history of nautical charts. Wright estimated the difference between San Miguel and Cabo da Roca in Portugal at 15°. The question of the variation of the compass is also considered in the legend, as in the text of 'Certain Errors.' A point of interest is the adoption of the westernmost point of Africa as the starting-point of longitude, which is made clear on the chart—an example that might have been followed with advantage by other cartographers.* It is to be noted that only

* The subject of the prime meridian in use by cartographers of the period is, as a rule, inadequately dealt with in text-books and works on the history of geography. No uniform system had been adopted at this time, but each cartographer made the selection that seemed to himself most suitable. A meridian much used was that of San Miguel in the Azores, though in some cases the line does not run accurately through the island.

an inferior copy of the chart was given in the 1610 edition of the book, from which all reference to Wright's patron, the Earl of Cumberland, was expunged.

Liverpool and District Geographical Association.

A movement towards the improvement of geographical education in Liverpool and its neighbourhood has been taken by the above association in the preparation of a scheme for a school course in geography, with notes and suggestions as to the methods of teaching to be recommended. It is signed by Mr. P. M. Roxby, President of the Association. While recognizing that the whole subject cannot be fully dealt with, it is held that, with suitable preparation of the ground by preliminary training during the first three years of school life, the next four should suffice "to handle geographical data rationally, and to relate the distribution of different phenomena scientifically." Physical geography should be taught with a view both to developing powers of observation and also providing the necessary basis for Human geography. Stress is laid on the desirability of paying more attention in future to World geography as concerned with the complex relationships of different lands and peoples, and on the need of improved equipment for schools. At a meeting of the Association on 17 March 1916 resolutions were passed embodying the views of those present in the above direction, and urging on the Education Authority the importance of providing adequate equipment for schools. The Secretary of the Association is Mr. A. B. Archer.

Argentine Meteorological Station at the South Orkneys.

Through the courtesy of the Foreign Office we have received the copy of a report from Buenos Aires announcing that the staff of the above station for the present year (consisting, as before, of Scandinavians—two Norwegians and three Swedes) sailed in the S.S. *Arpon* on 17 February 1916. They were to proceed first to South Georgia, going on thence by another vessel.

OBITUARY.

Sir Charles Watson.

THE death of Colonel Sir Charles Watson on March 15, after a few days illness, came as a great shock to his many friends, and has deprived the Society and the country of one who has done much for the organization of geographical and archæological research in Palestine. The son of William Watson, a well-known civil engineer, he was born in Dublin on 10 July 1844. After taking his degree with high honours at Trinity College, Dublin, and passing both in and out of Woolwich at the head of the list, he was commissioned lieutenant in 1866 in the Royal Engineers. The daily press has told in detail the story of his distinguished military career, and we will devote our space mainly to the archæological and geographical interests to which he gave so much of his time after his period of active service. It will suffice here to say that, after specializing at Chatham in submarine engineering, then in its infancy, he joined General Gordon for survey work in the Sudan in 1874, but was soon invalided home, though not before accomplishing a useful piece of work on the

According to Hues (who used the San Miguel meridian for the "Index Geographicus" given with his treatise on the Globes) it is the starting-point of longitude on the Molyneux Globe. In later times Ferro of the Canaries came into fashion (recalling the practice of Ptolemy and the geographers of the Renaissance, whose zero line ran through the group), and Tenerife was also much used.

Upper Nile (see *Journ. R.G.S.*, vol. 46, p. 412). In the following years he was engaged on plans for the defence of London under the Inspector-General of Fortifications, and later served for two years in the India Office. In 1880 he married a daughter of the Rev. Russell Cook and granddaughter of the scholar César Malan, of Geneva. When the Egyptian Expedition was sent out in 1882, he was appointed to the Intelligence Department, and the story of his ride to Cairo after the Battle of Tel-el-Kebir, and his capture, with a mere handful of men, of the citadel and its garrison of 6000 Egyptian troops, is one of the most dashing episodes in the annals of the British Army. For these services he received a brevet-majority and the order of the Medjidieh. He returned to Egypt in 1883, assisting Sir Evelyn Wood in the creation of an Egytian army, and for a time was Acting Sirdar. In 1885 he was decorated with the Osmanieh and given the rank of Pasha (major-general) in the Egyptian army; in the following year he acted for six months at Suakin as Governor-General of the Red Sea Littoral. From 1891 to 1902 he served as Assistant and Deputy Inspector-General of Fortifications, and during this period he studied the barrack system in Germany.

Sir Charles travelled much, and had long been a zealous supporter of the R.G.S., which he joined in 1875. In 1893 his services on its Council were secured for the first time, and were thenceforward freely at its disposal, with but occasional intervals, until a year ago. After his retirement from the army (when he received a C.B.) he acted as British Government Delegate to International Navigation Congresses at Düsseldorf in 1902, Milan in 1905, and Petrograd in 1908. His faculty for organization was utilized in 1904 when he served as Secretary to the Royal Commission for the St. Louis Exhibition and Commissioner-General, for which he received his K.C.M.G. His first visit to Palestine was in 1891, and during the following years he wrote and lectured much on Palestinian excavation. In 1905 he succeeded Sir Charles Wilson as Chairman of the Executive Committee of the Palestine Exploration Fund, and from that time until his death he took a leading part in organizing British excavation in that country.

The Fund had already conducted excavations at Tel Jezar, the site of the Canaanite city of Gezer, which was still a strong fortress in Maccabæan times and continued to be a place of importance after the occupation of Palestine by the Crusaders. The modern village was fortunately not on the mound itself but in the plain at one end of it, and excavations were unhampered over practically the whole of the site. The most interesting find, made during a second period of excavation in 1905–7, was an early Canaanite castle, built long anterior to the Hebrew occupation, probably at the time of the first colonization of the country by the Western Semites; it was furnished with a remarkable rock-tunnel leading by a flight of steps to an underground spring which served as the citadel's water-supply. The success of the Fund's work upon this site, and the monumental publication of the results, owed much to its chairman's energy and enthusiasm. A further important excavation was made in 1911–12 in another South Palestinian mound, Ain Shems, the site of Beth Shemesh, a city successively occupied by Canaanites, Philistines, and Hebrews. Here the pottery of the Philistine stratum proved of exceptional interest, for it was found to bear a strong resemblance to Ægean fabrics, and supported the view that the Philistines were a people who had come from oversea.

It is gratifying to recall that Sir Charles Watson lived to see the completion of the Fund's great survey of Palestine. The southern section, up to the Egyptian border, was brought to a successful conclusion shortly before the war,

and though the maps, for obvious reasons, have not yet been published, the archæological results were issued as the Annual Volume for 1914–15.

Last year Sir Charles completed ten years of strenuous work as Chairman of the Fund's Committee, and the Fund itself celebrated the fiftieth year of its activity in Palestine. To commemorate the latter event he prepared a record of the surveys, excavations, and researches it had carried out, and this has been issued under the title 'Fifty Years' Work in the Holy Land.' In 1912 he published a volume on 'Jerusalem' in the "Mediæval Towns Series," and it was illustrated by Lady Ward, who always accompanied him on his journeys in Palestine and elsewhere. For many years he was a contributor to the *Quarterly Statement* of the Fund, and to other archæological journals, more than one of his papers dealing with ancient weights and measures, a subject in which he took a keen interest; his study of 'British Weights and Measures' was published in 1910. He was a good Arabic scholar and issued vocabularies on Arabic, Hadendoa, etc., for the use of British troops in Egypt.

In 1906 he edited Sir Charles Wilson's 'Golgotha and the Holy Sepulchre,' and in the 'Life' he wrote of his friend, published in 1909, he successfully defended Wilson's conduct of the Gordon Relief Expedition. He always took a keen interest in historical research, especially in relation to the army, and he contributed the third volume to Whitworth Porter's 'History of the Royal Engineers.' At the present moment his paper on "Universal Service," written in 1909, is of peculiar interest, and its arguments have been fully justified. Sir Charles Watson was a man of great personal charm, of wide interests and ceaseless activity; and in all that he undertook he brought to bear, as one of his friends has lately told us, a perfect habit of method and order. His death is a very serious loss to Palestinian archæology and research.

L. W. KING.

Colonel Le Messurier.

Colonel Augustus Le Messurier, C.I.E., R.E., whose death from heart-failure at the age of seventy-eight years occurred on February 19, had been a Fellow of this Society since 1887. His active career was chiefly concerned with India and its north-west borderlands, but he gained distinction also in the Abyssinian Campaign of 1868. The son of A. S. Le Messurier, Advocate-General of Bombay, he entered the army in 1856, becoming Colonel in 1885, and retiring in 1893. After taking part in the Afghan war and completing further service in India he came home on furlough, and when returning to duty in 1887 decided to extend his knowledge of the countries between Europe and India by travelling overland by the Caucasus and Trans-Caspia. The journey was successful and gained him acquaintance with the Russian Trans-Caspian railway to Samarkand then in course of construction, on which he had some useful information to give in his book 'From London to Bokhara' published in 1889. India was reached after a ride across Persia from Resht to Bushire. Colonel Le Messurier served on the Council of the Society from 1899 to 1903.

Lady Baker.

Lady Baker, the heroic and intrepid companion of her husband, the late Sir Samuel Baker, during his explorations and campaigns on the Upper Nile, died on March 11 at the residence near Newton Abbot in Devonshire purchased by him at the close of his African career. Few if any lady travellers can have passed through more thrilling adventures than Lady Baker, who in all the dangers and difficulties of Sir Samuel's work among African savages and slave-hunters was ever at hand to aid and support him, taking part in strenuous

marches, carrying ammunition during actual fighting, and frequently taking charge of the camp during his absence. He wrote of her, in a letter quoted in his 'Life' by Murray and White: "She has always been my prime minister, to give good counsel in moments of difficulty and danger." By birth she was Hungarian, and her marriage with Sir Samuel was the outcome of an illness through which she nursed him with devoted care.

CORRESPONDENCE.

Some Limitations to Land Depletion by Rivers.

[*A reply to the letter from Prof. H. E. Gregory printed in the 'Geographical Journal,' 46, p. 402, following a note in 'Geographical Journal,' 45, p. 253, summarizing Dr. Keyes' note in 'Science'* (25 *December* 1914).]

PHYSIOGRAPHICALLY the Mississippi Valley possesses a number of features that are somewhat unique, and others that are little taken into account. As is well known the lower half of river, for a distance of more than 1000 miles, occupies an aggraded channel on the medial line of the broad delta built up in the ancient Mexican Gulf. The grade-plain at the head of this delta is now between 300 and 400 feet above sea-level. In the upper reaches of the stream, for another 1000 miles, the watercourse deeply carves its channel in the prairie plain worn out on the bevelled indurated strata of Palæozoic age.

It is, however, the western half of the broad Mississippi Basin to which attention is here particularly directed. This is a slightly inclined plain of remarkable evenness, 2000 miles long and 1000 miles wide east and west, that is not in any sense of the word a peneplain as is so commonly inferred. It is not a surface worn down by the traversing streams. It is chiefly a constructional plain over the large part of which incoherent detritus is hundreds of feet in thickness. These deposits are true continental or epeirotic deposits—materials laid down not in the sea, nor in vast fresh-water lakes as was once supposed, but directly upon dry land the surface of which is several hundreds of feet above sea-level.

The point intended to be brought out in recently challenging conclusions on the rate of continental lowering, with the interior region of North America as a concrete example, in no way militates against the accepted notion of the development of a geographical cycle with the river as the main sculpturing agency and the peneplain as the net or final result. The latter expresses the conception of the ideal or normal condition and product. There are necessarily conditions under which the ideal is not reached. With ever-decreasing rainfall there comes a time when the rivers no longer accomplish the work which they were once able to do when precipitation was copious. At length stream-work ceases to be the mastering corrasive power. Finally, erosive forces other than running water assume the ascendency. These appear to be precisely the conditions that obtain in the western half of the Mississippi Basin to-day. In so far as this vast tract is concerned the net corrasive results of the rivers appear to be *nil*. Prof. W. M. Davis and others even argue for prodigious aggradation of the region by the traversing streams. The balance of normal erosive effort is strongly against the rivers.

The Mississippi Valley presents another notable condition which has never been adequately considered. It lies to the leeward of the greatest arid tracts of the American continent. It receives the sands and dusts that are unceasingly exported by the winds from the dry region, which in volume far surpass the

total bulk of the sediments carried by any river. It is a principal area of vast eolic deposition. The western tributaries of the master-stream fall far short of transporting to the sea any appreciable proportion of this prodigious influx of wind-borne soils. For this reason it is that to a thickness of more than 1000 feet loams and sands accumulate where, in passing eastward from the desert, increasing rainfall stimulates the growth of verdure sufficiently to firmly bind the soil. Over such a region as this the volume of continental depletion, however large it may be, is many times each year replaced by soil materials exported from the arid country beyond the westernmost confines of the basin.

When considering the depletion of this region by the rivers another important factor has to be taken into account. In the distance of 2000 miles, between the southern boundary of Canada and the northern limit of Mexico, only five tributaries of the Mississippi River leave the Rocky Mountain front. As these streams debouch from the Cordilleran region they are quite small and in their onward courses they gain but slowly in volume. Examined in their entirety they can hardly be looked upon as exerting very much influence upon the general levelling and lowering of the Great Plains country which they traverse. Their relative insignificance in this respect explains at once why the recent stream-measurements of sediments carried out under the auspices of the American Government give results for the rate of continental lowering of the Mississippi Basin so excessively small.

The fact that these figures are so small should have at once aroused suspicion as to their correctness as a measure of actual continental lowering, carrying with it the necessary inference that in a given number of years the entire basin would be reduced to sea-level. As a matter of fact, according to the most available estimates, in the period mentioned the western half of the basin at least would be raised, provided diastrophic movement remained *in statu quo*, higher than the highest peaks of the bordering Rocky Mountains. The small amount of material carried into the sea from a given area has no genetic bearing whatever upon whether or not in that particular tract there is general lowering of the surface. In a normally moist climate the inference is, rightly of course, that this material represents the net amount of regional lowering. Under conditions of aridity these results do not obtain. In some semi-arid regions there may be actually extensive epeirotic deposition instead of general depletion.

In order that stream-measurements of sediments transported by such large drainage systems as that of the Mississippi River, for instance, may be made most trustworthy and susceptible to varied analysis, they probably should be determined separately for each of the larger tributaries. In the case of the river in question measurements for the Ohio River, the Missouri River, and the Upper Mississippi River above the mouth of the Missouri, would doubtless suffice. In the instance of the Missouri River it may be that by far the larger part, if not all, of its heavy silt burden is derived from the loess loams blown into its waters from the country through which it passes; and a very considerable part of this may be directly exported from the deserts beyond and entirely outside of the basin.

Viewed largely from the angle of the geographical cycle, the United States presents three distinct north and south belts of country, each about 1000 miles in breadth. In the easternmost belt the rivers are now performing normal corrasive work, and are manifestly rapidly reducing the positive features of landscape towards base-level. In the central belt—from the line of the Mississippi River to that of the Rocky Mountains—the rivers are not producing

appreciable corrasive results; the country is one of constant and rapid aggradation instead of degradation, and there can be here no normal cycle of stream-action. In the western belt—the arid lands—general stream work is almost unknown; the region is one of prodigious deflation; in it the rivers have no place in its geographical cycle; physiographical development is through means of eolic work; and there is no net or normal result of river erosion.

When, then, the figures of recent stream-measurements are called into question as expressing the rate of actual continental lowering, they may be shown to be highly misleading; and when the absence of normally controlling powers is pointed out, it is not for the purpose of challenging the verity of the normal geographical cycle. Attention is merely directed to the fact that in a concrete case, most unfortunately chosen, perhaps, the conclusions drawn are not warranted by the conditions present. Emphasis is placed upon the circumstance that there is an arid geographical cycle in which rivers may play not only small part, but in which winds become an erosive agency more potent than rain, river, or ocean.

Recalling the fact that nearly one-third of the land-surface of our globe is desert, and that there is another one-third in which rivers do not accomplish net corrasive results, it will be recognized that the normal geographical cycle really only applies to the remaining one-third. Therefore in over two-thirds of the world's land area rivers may hardly be regarded as entering into account as dominant factors of general erosion and continental lowering.

CHARLES KEYES.

Did Holland sell the Cape?

In his able paper on "Railway Development of Africa, Present and Future," in the January number of the *Journal*, Sir Charles Metcalfe states that "the English bought the Cape Colony from the Dutch in 1806." In that year there was no transaction concerning the Cape between the two nations. This, however, is a small matter about which I would not have troubled you. But I must contradict the substance of the statement itself—the fact of a sale at that or any other period.

This is an important matter, the more so as there is a widespread belief in the existence of such a sale, and this is now being supported by an authority on South African matters. Historical investigations of later years have brought the question to the full light.*

After Napoleon's defeat at Leipzig the Dutch were amongst the first who threw off the French yoke; they invited the Prince of Orange, son of the last Stadhouder, to come over from England and put himself at the head of the nation.

As early as 28 November 1813 G. K. van Hogendorp, who had taken provisional charge of public affairs, wrote to Fagel, who was going to represent the newly reborn state in London: "At the same time I must acquaint England that my country expects the prompt and unconditional surrender of the Colonies in all the three parts of the world. We have the firm confidence that England will not retain anything of what belongs to us."

On 3 December 1813 Malmesbury answered as follows: "It is very natural for Hogendorp to wish even in the moment of their just enthusiasm to have back all the Colonies we have taken from you. But I think that, on more calm reflection, he may alter this opinion and consider they will require a strong

* Chiefly by Prof. Dr. Heeres, of the Leyden University; the ex-Director of Education in Netherlands India, P. H. van der Kemp; the Director of the State Bureau for Publication of Historical Documents, Dr. T. H. Colenbrander; and the French author Déhérain.

military force to defend the Cape and Ceylon, safer in our possession than on being restored to them."

Negotiations were continued until 10 August 1814, when William I. wrote to his minister Nagel that it cut him to the heart "to have to accede to principles that are not so liberal as we might have expected, but which we are unable to alter." He added: "We are in the unfortunate necessity to yield, where resistance would be useless and detrimental."

Three days later he signed the treaty by which the Netherlands had to abandon Cape Colony and a considerable part of their West Indian colonies. Consequently there was no question of a sale.

But the treaty might still have been an expropriation; in that case the Netherlands would at least have received an indemnity for giving up part of their colonies. Such a conclusion would be erroneous. The payment by England of £6,000,000 is bracketed with the cession of the different colonies. But in reality there is no connection whatever between payment and cession. These two were purposely coupled together in order to make the payment of that sum acceptable to the British Parliament, which was thereby led to believe that by voting this sum it obtained an increase of British colonial possessions. It was "the necessity of having something to hold forth to the public," as Castlereagh wrote on 30 July 1814 to the British Ambassador at the Hague. The fact is that the Netherlands never touched a single penny of those six million pounds. England *did* pay this sum, at least the greater part of it, but to others, and in fulfilment of obligations she had undertaken on her own account and with which the Netherlands were now saddled by secret treaty, since published.

The clear conclusion is, that the Netherlands neither sold the Cape nor were indemnified for the loss of that colony. They could not sell colonies, because they had possession of none. It was England who was in possession, and who by this treaty obtained a lawful title to those of the Dutch colonies which she declined to hand back.

HENDRIK P. N. MULLER.

MEETINGS: ROYAL GEOGRAPHICAL SOCIETY: SESSION 1915-1916.

Tenth Evening Meeting, 3 April 1916.—The President in the Chair.

ELECTIONS.—Robert Vyvyan Dent; Captain G. Blenkhorn Harland; Major-General W. A. Lawrence, I.A.; Samuel Nivison.

PAPER: Geographical Problems in Boundary Making. Colonel Sir Thomas H. Holdich.

Eleventh Evening Meeting, 17 April 1916.—The President in the Chair.

ELECTIONS.—George E. Davis; Mrs. Andriana Hailey; Major Herbert Andrews Newell, I.A.; Lieut.-Commander James Cautrell Johnstone Soutter, R.N.; T. S. Tomlinson; Hon. T. R. J. Ward, C.I.E., M.V.O.; William Henry West.

PAPER: The Development of Rhodesia from a Geographical Standpoint. H. Wilson Fox.

Sixth Afternoon Meeting, 13 April 1916.—The President in the Chair.

PAPER: Night Marching by Stars. E. A. Reeves.

NEW MAPS AND PHOTOGRAPHS: ADDITIONS TO THE MAP ROOM. E. A. Reeves, Map Curator, R.G.S.

EUROPE.

Austria-Hungary. **Langhans.**

Die Latinität der adriatischen Kuste Österreich-Ungarns. Entworfen von Paul Langhans. Scale 1 : 450,000 or 1 inch to 7·1 stat. miles. Size 18 by 15 inches. *Petermanns Geogr. Mitteilungen*, Jahrgang 1915, Tafel 54. Gotha: Justus Perthes, 1915.

This map is based upon Mayer's 'Atlas der Alpenländer,' with various tints superimposed showing the distribution of languages of the peoples of the Austrian Adriatic coast. It accompanies a paper by Prof. Georg. Lukas in *Petermanns Geogr. Mitteilungen* for November last.

Balkan Peninsula. **Stanoïévitch and Derocco.**

Carte de l'Extension Ethnique de la Nation Serbo-Croato-Slovène. Par St. Stanoïévitch et D. J. Derocco. Scale 1 : 1,500,000 or 1 inch to 23·7 stat. miles. Size 26 by 23 inches. Nish, 1915. *Presented by Dr. P. Karovitch.*

Includes the Austrian shores of the Adriatic with the adjacent countries. The territories inhabited by the Serbo-Croato-Slovene population are shown in a blue tint, and those areas where this population is only sparce or scattered by blue diagonal lines. International boundaries are indicated by bold purple lines.

Balkan Peninsula. **E. Stanford, Ltd.**

The Theatre of War in the Balkan Peninsula. Stanford's War Maps, No. 16. Scale 1 : 1,140,000 or 1 inch to 18 stat. miles. Size 26 by 39 inches. London: Edward Stanford, Ltd., 1916. *Presented by the Publishers.*

A boldly-drawn map showing land relief by various tints of reddish-brown, increasing in intensity with the altitude and changing at the 500, 1000, 2000, and 5000 contours. Boundaries, railways, roads and names of all principal places are given.

Belgium. **Langhans.**

Die Verwaltung des Gebiets der Kaiserl. Deutschen General-Gouvernements in Belgien am 1 Oktober 1915. Nach amtlichen Angaben entworfen von Paul Langhans. Scale 1 : 1,110,000 or 1 inch to 17·5 stat. miles. Size 8 by 13 inches. *Petermanns Geogr. Mitteilungen*, Jahrgang 1915, Tafel 53. Gotha: Justus Perthes, 1915.

Shows by different tints the parts of Belgium and France under the administration of the Imperial German Government in Belgium on October 1 last, the part in German military occupation, with military stations, but not placed under this administration, railways open for commercial traffic, those for military purposes only, German postal and telegraph administration, and other information connected with the present German occupation of Belgium. The map accompanies a note in *Petermanns Geogr. Mitteilungen* for November last.

British Isles—Scotland. **Railway Clearing House.**

Official Railway Map of Scotland. Scale 1 : 475,200 or 1 inch to 7·5 stat. miles. Two sheets each 21 by 27 inches. Prepared and published at the Railway Clearing House, London, 1916. *Price 8s. 6d.*

This is a new edition.

France. **E. Stanford, Ltd.**

Stanford's Half-Inch Map of the British Front in France and Flanders. Stanford's War Maps, No. 17. Scale 1 : 126,720 or 1 inch to 2 stat. miles. Size 38 by 19 inches. London: Edward Stanford, Ltd., 1916. *Price 3s. Presented by the Publishers.*

This map includes an area that is interesting at the present time in connection with British military operations, and extends from just north of Ypres to about 10 miles south of Albert. The approximate line of battle front on March 1 last is shown by a bold red line. Land below 125 feet is left white, after that two tints of reddish-brown show land between 125 and 250 feet and above 250 feet. Railways, roads, canals, woods and other information are given.

Italy. **Istituto Geografico Militare, Florence.**

Carta corografica ipsometrica del Regno d'Italia e delle regione adiacenti. Scale 1 : 500,000 or 1 inch to 7·9 stat. miles. Sheets: 5, Wien; 8, Venezia; 9, Udine; 10, Agram; 12, Genova; 14, Ancona; 18, Roma-Perugia; 19, Chieti; 24, Napoli. Size 15 by 20 inches. Florence: Istituto Geografico Militare, 1914. New editions. *Price* 3*L. each sheet.*

Shows relief on the layer system, in shades of green and brown, with contour intervals varying between 100 and 400 metres. Up to 300 metres the interval is 100 metres; then the 500, 800, 1000, 1300, and 1600 metre contours are drawn, and after that the interval is 400 metres.

Italy. **Artaria.**

Carta Nautica e Ferroviaria d'Italia. Scale 1 : 1,400,000 or 1 inch to 22·1 stat. miles. Size 31 by 28 inches. Milano: Ditta Editrice Artaria di Ferd. Sacchi & Figli, [1916].

An outline map showing railways in red and steamer tracks round the coast in black.

Netherlands. **Beekman, Blok and Overvoorde.**

Geschiedkundige Atlas van Nederland. Uitgegeven door de Commissie voor den Geschiedkundigen Atlas van Nederland en geteekend door het lid der Commissie Dr. A. A. Beekman. De Bourgondische Tijd. De Rechterlijke Indeelingen na 1795. Door Dr. J. C. Overvoorde. The Hague: Martinus Nijhoff, 1915.

The first of these two parts of this important historical atlas of the Netherlands contains three maps dealing with the country during Bourbon times in the latter part of the fifteenth century, accompanied by a pamphlet of 94 pages by Dr. P. J. Blok.

The second part contains three maps showing the judicial divisions (1) according to the French laws of 1810 and 1811, and (2 and 3) according to the laws of 24 December 1828 and 9 April 1877. The various boundaries with their explanations are clearly shown in red, together with other information, and the maps give only just what is necessary for the purpose, and so are not overcrowded. Accompanying the maps are 30 pages of text by Dr. J. C. Overvoorde.

Sweden. **Generalstab, Stockholm.**

Generalstabens höjdkarta öfver norra Sverige. Scale 1 : 500,000 or 1 inch to 7·9 stat. miles. Sheet VI. Size 14 by 19 inches. Stockholm: Generalstabens Litografiska Anstalt, 1915.

This sheet includes the area to the east of the Norwegian frontier lying between 63° 18′ and 64° 52′ N. Relief is well shown on the layer system in shades of yellow and reddish-brown, changing at every 100 metres. On land below 500 metres two equidistant intermediate contour lines are added in dotted lines.

Turkey. **Geographical Section, General Staff.**

Map of the Anzac Position, Gallipoli, to illustrate Sir Ian Hamilton's despatch of 11 December 1915. Scale 1 : 20,000 or 3·2 inches to 1 stat. mile. Size 36 by 20 inches. Geographical Section, General Staff, War Office, 1916. London Agents: E. Stanford, Ltd.; Sifton, Praed & Co.; T. Fisher Unwin. *Price* 1*s. net. Presented by the Director of Military Intelligence.*

Shows relief in brown contours at 10-metre intervals. The British and Turkish trenches, as known on 6 August 1915, are shown by red and blue lines respectively.

ASIA.

India. **Surveyor-General of India.**

Maps published by the Survey of India during the quarter ending 31 December 1915. **India and adjacent countries,** scale 1 : 1,000,000, sheets (layered and shaded, layered only, shaded only), 41, 47, 57 and part 66, 72, 74. **Degree Sheets,** scale 1 inch to 4 miles, sheets (provisional issue), Bombay and Hyderabad, 56 B, 56 D; Bombay, Madras, Mysore, and Hyderabad, 57 A; Central India and Central Provinces, 46 N; Central India and United Provinces, 63 G; Hyderabad, 56 H; Hyderabad and Central Provinces, 56 N; Hyderabad, Madras, and Central Provinces, 65 B; Madras, 58 F, 65 H, 65 K; Madras, Bihar, and Orissa, 64 P; Madras and Hyderabad, 57 E, 65 D. **Half-inch Sheets,** scale 1 inch to 2 miles, sheets (preliminary issue): Berar and Hyderabad, 56 E–SE. **Standard Maps,** scale 1 inch to 1 mile, sheets: Berar, 55 D–11, 55 D–15, 56 A–9; Berar and Hyderabad, 56 I–5, 56 I–9; Bihar and Orissa, 72 C–12, 72 C–15, 72 D–1, 73 E–5, 73 E–10, 73 E–11, 73 E–14, 73 E–15, 73 H–12, 73 J–2 (preliminary editions with village boundaries); Central

India and Central Provinces, 55 I–12; Central Provinces, 55 J–14, 55 J–15, 55 J–16, 55 K–11, 55 K–12, 55 K–13; Kashmir and Jammu, 43 N–6; Madras, 57 H–16, 57 L–3, 57 L–4, 57 L–11, 57 L–13; Madras and Mysore, 57 H–10, 57 H–11, 57 H–13, 57 L–1; Punjab, 53 C–12, 53 C–15; Punjab and United Provinces, 53 F–12, 53 G–3; United Provinces, sheets 53 G–6, 53 G–7, 53 G–10, 53 G–13, 53 G–15, 54 N–1, 54 N–10, 63 I–12. Calcutta: Map Record and Issue Office, 1916. *Presented by the Surveyor-General of India.*

Malay Peninsula. **Surveyor-General, F.M.S.**

Pahang, Federated Malay States, 1912. Revised, with hills, 1915. Scale 1 : 253,440 or 1 inch to 4 stat. miles. Six sheets each 15 by 26 inches. Kuala Lumpur: Central Survey Office, 1915. *Presented by the Surveyor-General of the Federated Malay States.*

A new edition of a general map of Pahang published in 1912. Hills are shown in brown shading. By tints and symbols in green and red alienated agricultural and mining lands and forest reserves are shown. It is evident that much of the country still remains entirely unsurveyed.

Turkey. **Bacon.**

Bacon's War Map of Mesopotamia, including all Turkey in Asia. Scale 1 : 3,400,000 or 1 inch to 5·3 stat. miles. Size 17 by 27 inches. London: G. W. Bacon & Co., Ltd., 1916. *Price 6d. net. Presented by the Publishers.*

The title is hardly correct since this map does not include the whole of Turkey in Asia, the Hejaz and Yemen being entirely omitted. Relief (roughly shown in outline), rivers and names are in black, seas and lakes blue; railways, which are in red, need revision.

Turkey. **E. Stanford, Ltd.**

Stanford War Maps, No. 9. The Seat of War in Turkey. Scale 1 : 3,220,177 or 1 inch to 50·7 stat. miles. Size 26 by 38 inches. London: Edward Stanford, Ltd., 1914. *Price 5s.*

The area included in this map extends from Rumania to Egypt, and from Montenegro to the Persian Gulf. Attempt has been made to give some idea of the relief by neutral tint shading. Railways are clearly indicated in red; but the Baghdad line might have been shown as open as far as Ras el Ain.

AFRICA.

Egypt. **Survey of Egypt.**

Topographical Map of Egypt. Scale 1 : 50,000 or 1·3 inch to 1 stat. mile. Second edition. Sheets: I.–II. N.E., Cairo East; III.–IV. N.E., Tel el Kebir; VII.–VI., N.E., Port Said; II.–I. N.W., Ashmûn; III.–I. N.W., Minûf; V.–V. N.W., Ikingi Maryût; V.–VI. N.W., Bahîg; V.–VII. N.W., Et Hammam; VI.–IV. N.W., Kafr Ed-Dauwâr; VI.–V. N.W., Alexandria; VII.–V. N.W., Ramleh; V.–I. S.E., Beni Suef; XXIV.–VII. S.E., Isna; III.–I. S.W., Sinnûris; III.–II. S.W., Birket Qârûn; III.–III. S.W., Qasr Qârûn; IV.–I. S.W., Madînet El-Fayum; IV.–II. S.W., En-Nazla; IV.–III. S.W., Bahr El-Wakîl; V–II. S.W. El-Gharaq Es-Sultâni; VI.–I. S.W., Beba; VII.–I. S.W., Maghâgha; VIII.–II. S.W., Bardanûha; XII.–I. S.W., Mallawi. Giza: Survey of Egypt, 1914–15. *Presented by the Director-General, Survey of Egypt.*

Egypt. **Survey of Egypt.**

Topographical Map of Egypt. Scale 1; 250,000 or 1 inch to 3·9 stat. miles. Sheets: 1–E., North-West Delta, 1914; 1–F, North-East Delta, 1914; 2–E, South-West Delta, 1914; 2–F, South-East Delta, 1914; 3–E, Fayum, 1914; 3–F, El Saf, 1912; 4–D, Baharia Oasis (Provisional Issue), 1915; 4–E, El Minia, 1913. Size 18 by 23 inches. Giza: Survey of Egypt. *Presented by the Director-General, Survey of Egypt.*

Egyptian Sudan. **Survey Office, Khartoum.**

Africa. Scale 1: 250,000 or 1 inch to 3·9 stat. miles. Anglo-Egyptian Sudan. Sheets: 54–P, Abu Zabad; 66–C, Roseires. Size 18 by 26 inches. Compiled and zincographed at the Survey Office, Khartoum, 1915. *Price 10 P.T. each sheet. Presented by the Director of Surveys, Khartoum.*

The Abu Zabad sheet extends from 12° to 13° N. lat. and from 28° 30′ to 30° E. long., and the Roseires sheet from 11° to 12° N. lat. and from 33° to 34° 30′ E. long. A great deal of the area included on both is still unexplored, and much of the mapping shown can only be approximate. A list of the data used in the compilation is given at

the bottom of each sheet. Hills are shown by horizontal form lines in brown and water in blue.

German East Africa. **Sifton, Praed & Co.**

Sifton Praed's Map of German East Africa. Scale 1 : 2,500,000 or 1 inch to 39·4 stat. miles. Size 21 by 22 inches. London : Sifton, Praed & Co., Ltd., 1916. *Price 2s. Presented by the Publishers.*

A rough and not very accurately drawn map. Attempt has been made to show relief by horizontal form lines in black, while rivers and lakes are in blue. Greater care might have been given to railways ; for instance, the line running from Dar-es-Salaam to Lake Tanganyika is shown as ending at Ujiji, whereas as a fact its terminus is Kigoma, to the north of Ujiji, a place which is not shown at all.

AMERICA.

Alaska. **Martin and Maddren.**

Map of the Bering River Coal Field showing distribution of the various kinds of coal and location of the coal sections and coal samples described in Bulletin 335. By G. C. Martin, assisted by A. G. Maddren. Survey in 1905 and 1906. Scale 1 : 62,500 or 1·1 inch to 1 stat. mile. Size 36 by 34 inches. Washington : U.S. Geological Survey, 1914. *Presented by the Director, U.S. Geological Survey.*

The Bering River Coal Field here shown is situated about 10 miles up the Bering River on the Pacific coast of Alaska. On a topographical map of the usual excellent style of the U.S. Geological Survey, the various kinds of coal are shown by different tints, while vertical sections are given at the side. There is also on the map a table giving the results of analyses and tests of the Bering River coals.

Canada. **Dept. of Mines, Ottawa.**

Geological Survey of Canada. Maps : 110A, Prescott, Paxton and Lake Mines, Texada Island, B.C., scale 1 : 4800 or 13·2 inches to 1 stat. mile, size 9 by 24 inches, 1915 ; 111A, Vanada, Texada Island, B.C., scale 1 : 24,000 or 2·6 inches to 1 stat. mile, size 8 by 18 inches, 1915 ; 116A, South-Western Ontario, scale 1 : 760,320 or 1 inch to 12 stat. miles, size 17 by 19 inches, 1914 ; 142A, Field, Kootenay District, B.C., scale 126,720 or 1 inch to 2 stat. miles, size 13 by 8 inches, 1915 ; 147A, Cranbrook, Kootenay District, B.C., scale 1 : 253,440 or 1 inch to 4 stat. miles, size 14 by 17 inches, 1915. Ottawa : Department of Mines, Geological Survey, 1914-1915. *Presented by the Department of Mines, Ottawa.*

A series of geological maps of special districts of Canada, to accompany the memoirs of the various authors.

Canada. **Dept. of Mines, Ottawa.**

Geological Survey of Canada. Map 41A, Duncan, Vancouver Island, scale 1 : 125,000 or 1 inch to 1·9 stat. miles, size 18 by 12 inches. Ottawa : Department of Mines, Geological Survey, 1915. *Presented by the Department of Mines, Ottawa.*

An interesting specimen of topographical mapping, including the south-east coast district of Vancouver Island to the north of Victoria from Saanich Inlet to Ladysmith. The relief is effectively represented by contours in brown at 100-feet intervals ; water is shown in blue, and names, roads, and railways in black. There is a good and complete explanation of the symbols employed. The map is based upon the triangulation of Mr. S. C. McLean in 1909, and the topography is from surveys of Messrs. R. H. Chapman and K. G. Chipman in 1910. The map not only forms a good basis for the geological mapping of the area embraced, but will be useful for general purposes as well.

Canada. **Dept. of the Interior, Ottawa.**

Sectional Map of Canada. Scale 1 : 190,080 or 1 inch to 3 stat. miles. Sheets : 119, Regina, Saskatchewan, 7th edit., 1915 ; 216, Sullivan Lake, Alberta, 7th edit., 1915 ; 365, Victoria, Alberta, 7th edit., 1915 ; 513, Heart River, Alberta, 3rd edit., 1915. Size 18 by 30 inches. Ottawa : Department of the Interior, 1915. *Presented by the Department of the Interior, Ottawa.*

Canada—British Columbia. **Dept. of Lands, B.C.**

Cariboo and adjacent districts. Scale 1 : 500,000 or 1 inch to 7·9 stat. miles. Size 43 by 31 inches. Victoria : Department of Lands, 1916. *Presented by the Surveyor-General of British Columbia.*

Canada—Ontario. **Dept. of Lands, Toronto.**

Map of the Province of Ontario, showing districts, counties, townships, post offices, railway stations, steam and electric railways, canals and roads. Scale 1 : 500,000 or

1 inch to 7·89 stat. miles. Three sheets each 54 by 37 inches. Toronto: Department of Lands, Forests, and Mines, 1915. *Price, unmounted*, $1.00; *mounted*, $2.00. *Presented by Mr. W. R. Roger, Topographer, Department of Lands, Toronto.*

In consequence of a felt need for a new and up-to-date map of Ontario prepared under the supervision of some Department of the Provisional Government, about two years ago the Hon. W. H. Hearst, then Minister of Lands, Forests and Mines, took the initiative in the matter, and the staff of the Bureau of Mines was entrusted with the preparation of this map, which has been compiled from all the best available information.

Amongst the documents used are the standard topographical maps of the Department of the Interior; the contoured topographical maps of the Department of Militia and Defence; the United States Geological Survey base maps of Michigan, Ohio, Pennsylvania, and New York; charts of the great lakes by the Corps of Engineers, U.S. War Department; plans on record in surveys of the Colonization Roads and Northern Development Branches, Ontario; and the Canadian Official Postal Guide.

The map is in three sheets, one of which consists of two separate parts. When the sheets are mounted together the whole measures 7 by 7 feet. Owing to its size and irregular shape the entire province could not be conveniently shown on one scale, and so the partially developed northern lands bordering on Hudson Bay are given, together with a repetition of the southern part, on the reduced scale of 1 : 2,217,000 or 1 inch to 35 miles. For the sake of ready comparison it would have been preferable to have selected some scale for this second map which would have been an even multiple of 1 : 500,000, which is the scale of the principal map.

The map is evidently drawn on a conical projection, although particulars are not stated.

The work of compilation has been carefully done, and the general execution is creditable both as regards draughtsmanship and the colour printing by which county boundaries, rivers, lakes, etc., are clearly distinguished. The depths of the great lakes are shown by different tints of blue increasing in intensity and changing with the contour lines of 10, 30, 50, 75, and 100 fathoms. No contours are drawn on the land, and only by means of scattered spot-heights, occurring as a rule up river-beds, and a dotted line showing the watershed between the Hudson Bay and St. Lawrence drainage systems, is the land relief indicated at all.

Roads, canals, railways both steam and electric, railway stations, townships, and post offices are all laid down, and by means of numerous printed notes on the map a considerable amount of statistical information concerning the province is given.

It is satisfactory to note that the Department of Education in the revised regulations for 1915 has prescribed that this map shall form part of the minimum equipment of the public and separate schools of Ontario. For a school wall-map much of the work is far too fine and can only be read on close inspection.

United States. **Rand, McNally & Co.**

Rand-McNally Indexed Pocket Maps: Maryland and Delaware, scale 1 : 600,000 or 1 inch to 9·5 stat. miles, size 19 by 26 inches; Virginia, scale 1 : 887,040 or 1 inch to 14 stat. miles, size 19 by 26 inches. Chicago and New York: Rand, McNally & Co., 1915.

These are new editions.

United States. **U.S. Geological Survey.**

Carte Internationale du monde au Millionième (1 inch to 15·78 stat. miles). North America. Sheet North I. 10, Point Conception. Size 18 by 22 inches. Compiled, engraved, and published by the United States Geological Survey, George Otis Smith, Director. Washington, 1915. *Presented by the Director, United States Geological Survey.*

This sheet adjoins the San Francisco Bay sheet, which was noticed in the *Geographical Journal* for November last, immediately to the south, and gives the continuation of the Pacific coast of California as far as Point Conception, San Miguel and Santa Rosa Islands. Only the north-east corner of the sheet is occupied by land, and by far the greater portion is taken up with the adjacent Pacific Ocean. Relief is indicated by layer tints in general conformity with the international arrangement for the production of this map, except, as in the San Francisco Bay sheet, the pink by which heights above 1000 metres are shown might have been improved and made brighter with advantage. The layer tints on the land change at the 200, 500, and 1000 metres contours, but intermediate contours are drawn at every 100 metres, with the 50-metre line on the lower lands. Ocean depths are shown by five tints of blue, changing at the 200, 500, 1000, and 3000 metres contours, while intermediate contours at every 100 metres are given with the 50-metre contours near the coast. The sheet has been carefully produced.

United States. **U.S. Geological Survey.**

Topographical maps of the United States, issued May 1–November 23, 1915. Scale 1 : 250,000 (1 inch to 3·9 stat. miles), sheets: Big Bar and vicinity, Cal.; *Massachusetts and Rhode Island; Mount Baker District, Wash. Scale 1 : 125,000 (1 inch to 1·9 stat. miles), sheets: Benson, Ariz.; Hominy, Okla.; Longs Peak, Colo.; Mojave, Cal.; Morenci, Ariz.-N. Mex.; Priest Valley, Cal.; *Rapids, S. Dak.; Summitville, Colo; *Yellowstone National Park, Cal. Scale 1 : 62,500 (1·014 inch to 1 stat. mile), sheets: Alger, Ohio; *Bakersfield, Cal.; Bering River Coal Field, Alaska; Brinkhaven, Ohio; Brilliant, N. Mex.-Colo; Chateaugay, N.Y.; Clintwood, Va.-Ky.; *Concord, Cal.; Coshocton, Ohio; Crestline, Ohio; Crow Creek, Idaho-Wyo.; Cuyuna, Minn.; Fairfax, Va.; Falls City, Nebr.; Frazer, Mont.; Grass Creek basin, Wyo.; Hacker Valley, W. Va.; Hamakua, Hawaii; *Haywards, Cal.; Hindman, Ky.; Honomu, Hawaii; Hoquiam, Wash.; Howe, Nebr.; Kenton, Ohio; Marengo, Ohio; Maricopa, Ariz; Milford, Pa.-N.Y.-N.J.; Millersbury, Ohio; Mount Olive, Ill.; Mount Rainier National Park, Wash.; Northeast, Pa.-N.Y.; Norwalk, Ohio; Ocosta, Wash.; Oswego, Mont.; *Ottawa, Ill.; Palatka, Fla.; Perham, Minn.; Pickens, W. Va.; *Reading, Pa.; *San Francisco, Cal.; San Francisco and vicinity, Cal.; *San Mateo, Cal.; Seaford, Del.-Md.; Soda Canyon, Colo.; Somerset, Pa.: *Spearfish, S. Dak.; *Sturgis, S. Dak.; Summersville, W. Va.; Vincennes, Ill.-Ind.; Waldoboro, Maine; Waynesville, Ohio; Wenatcher, Wash.; Wellington, Utah. Scale 1 : 31,680 (2 inches to 1 stat .mile), sheets: Elkhorn Weir, Cal.; Kirkville, Cal.; Merritt, Cal.; Oakdale, Cal.; Ripon, Cal.; Ronda, Cal.; Salida, Cal.; Swingle, Cal.; Thalheim, Cal.; Trigo, Cal.; Westley, Cal.; Westport, Cal.; Yolo, Cal. Scale 1 : 24,000 (2·6 inches to 1 stat. mile), sheet: Yerington district, Nev. Scale 1 : 12,000 (5·3 inches to 1 stat. mile), sheet: *Kern River Oil Field, Cal. Washington: Department of the Interior, U.S. Geological Survey, 1915. *Presented by the Director of the U.S. Geological Survey.*

* The sheets marked with an asterisk are new editions.

United States—California. **U.S. Geological Survey.**

San Francisco and vicinity, California. From Geological Survey atlas sheets. Surveyed in 1892–1913. Culture revision of San Francisco, Oakland, Alameda, Berkeley, and Richmond in 1913–1914. P. R. Marshall, Chief Geographer. Scale 1 : 62,500 or 1·1 inch to 1 stat. mile. Size 47 by 33 inches. Washington: U.S. Geological Survey, 1915. *Presented by the Director, U.S. Geological Survey.*

A good map showing the topographical features very clearly. Brown contours at 25-feet vertical intervals serve well to indicate the relief, and water is in blue. Only important place-names are given. Railways and principal roads are laid down.

United States—California. **U.S. Geological Survey.**

Topographic map of Yosemite National Park, California. From Geological Survey Atlas Sheets. Surveyed between 1893 and 1909. R. B. Marshall, Chief Geographer. Scale 1 : 125,000 or 1 inch to 1·9 stat. miles. Size 27 by 28 inches. Washington: U.S. Geological Survey, 1915. *Presented by the Director, U.S. Geological Survey.*

A useful general map of this interesting district. Relief is well brought out by contour-lines in brown at 100-feet intervals. The style in which the sheet is produced is similar with that of all the sheets of the topographical maps of the U.S. Geological Survey.

United States—Massachusetts. **U.S. Geological Survey.**

Topographic map of Massachusetts and Rhode Island. Compiled from U.S. Geological Survey Atlas Sheets. Surveyed in 1884–1888 in co-operation with the States of Massachusetts and Rhode Island. Scale 1 : 250,000 or 1 inch to 3·9 stat. miles. Size 30 by 50 inches. Washington: U.S. Geological Survey, 1915. *Presented by the Director, U.S. Geological Survey.*

Relief is indicated by brown contours at 100-feet vertical intervals, and water in blue. Railways are shown. The map is not overcrowded with names.

AUSTRALASIA.

New South Wales. **Dept. of Mines, Sydney.**

Geological Map of New South Wales. Prepared under the direction of E. F. Pittman, A.R.S.M., Government Geologist. Scale 1 : 1,013,760 or 1 inch to 16 stat. miles.

Two sheets each 43 by 28 inches. Sydney: Department of Mines, 1914. *Presented by the Minister of Mines, New South Wales.*

A general geological map, compiled from all available sources including the detail surveys of the Southern, Western and Hunter River Coalfields, the Tingha, Emmaville and Wilson's Downfall Tinfields, the Cobar Goldfields, and rapid field observations. The various formations are clearly distinguished and shown by well-chosen colours and symbols. An important note is given on the sources and reliability of the data, which have evidently been utilized to the best advantage by Mr. E. F. Pittman, the Government geologist, in the preparation of the map. A general map of Australia is given as an inset.

PHOTOGRAPHS.

Asia. **Lamley.**

Nine photographs of Batum and Trebizond, taken by G. Lamley, 1916. Size 6 by 8 inches. *Presented by Mr. G. Lamley.*

(1) Oil reservoirs, Batum; (2) Frontier mountains between Russia and Turkey-in-Asia, south of Batum; (3) Trebizond Harbour; (4) Trebizond from side of the western ravine; (5) Trebizond central hill between the ravines, where the old city was situated; (6) Trebizond old castle, on central hill; (7) Trebizond, ruins of old Greek walls; (8) Greek nunnery on slopes of Boz Tepe above Trebizond; (9) Old tomb in Turkish cemetery, Trebizond.

Japan. **Heimann.**

Two albums containing 166 photographs of Japan, collected by Charles A. Heimann. 1870–72. *Presented by Mr. C. A. Heimann.*

These two albums have a special interest since the views they contain were taken nearly fifty years ago, and consequently will be useful for comparison with those of recent date. Kobé was opened to foreign trade in 1868, and building on the foreign concession was commenced in 1870. The photographs give a good representation of the port as it then existed. Mr. Heimann was one of the party of four who were the first foreigners to visit Kyoto after it was opened to the world, as previously it had only been visited by members of the legation. Many of the Kyoto temples are shown in the photographs. Among other views of special interest are those showing the effects of the typhoon at Kobé on 4 July 1871. They are all well-preserved silver prints, measuring from 6½ to 8½ inches to 8½ by 12 inches.

(1–4, 19–24, 26, 27, 38–44, 46–49) Hyogo, 1871; (5–7) Hyogo after the typhoon of July 1871; (8–13) Kobé, effects of the typhoon of 4 July 1871; (14–17, 30, 51) Hills behind Hyogo; (18) Kobé, main street; (25) Tokaido, between Hyogo and Akashi; (28, 31) Akashi; (29) First tunnel on the railway between Hyogo and Osaka; (32) The Governor and Foreign Consuls of Hyogo; (33–35) Hyogo races; (36) Hyogo and Osaka Freemasons' Lodge, No. 498 S.C., November 1871; (45) Railway bridge across the new watercourse, Hyogo; (50) The second tunnel on the railway between Hyogo and Osaka; (52, 53) Osaka; (54, 55) Temple of Tennoji, Osaka; (56–60) Osaka; (61) The Mikado at Nagasaki (photograph of a drawing); (62, 63) Nagasaki; (64) Old Trinity Church, Shanghai; (65–67) Temple at Fushimi; (68–98, 100–116) Kyoto; (117) Kyoto carts and oxen; (99) Falls of Arasiyama, near Kyoto; (118, 119) Bridge at Otsu, Lake Biwa; (120) The Osaka River, looking from Lake Biwa; (121–124) Temple of Ishi-yama, Lake Biwa, May 1872; (125–127); Theatre, Kyoto; (128) Tea-house, Kyoto; (129–134) Kyoto Geishas; (135, 136) Kango, Kyoto; (137–139) Yokohama; (140–147, 149–156; Yedo (Tokyo); (148) View at Hayama; (157) The Tokaido, between Yokohama and Fujiyama; (158) Fujiyama from Subashin; (160) Daibutsu, Kamakura; (161) Bronze statue at the Temple of Katasi; (162) Tea-houses, Oji, suburb of Tokyo; (164) Pupils of the Tokyo hospital; (165) The steamer *Lye-e-moon* (coloured).

N.B.—It would greatly add to the value of the collection of Photographs which have been established in the Map Room, if all the Fellows of the Society who have taken photographs during their travels, would forward copies of them to the Map Curator, by whom they will be acknowledged. Should the donor have purchased the photographs, it will be useful for reference if the name of the photographer and his address are given.